SNS 100000000-PN0002-R00

Accelerator Systems Division Installation Plan

January 2002

A U.S. Department of Energy Multilaboratory Project

SPALLATION NEUTRON SOURCE

Argonne National Laboratory • Brookhaven National Laboratory • Thomas Jefferson National Accelerator Facility • Lawrence Berkeley National Laboratory • Los Alamos National Laboratory • Oak Ridge National Laboratory

SNS

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ACCELERATOR SYSTEMS DIVISION INSTALLATION PLAN

Date Published: January 2002

Prepared for the
U.S. Department of Energy
Office of Science

UT-BATTELLE, LLC
managing
Spallation Neutron Source activities at

Argonne National Laboratory	Brookhaven National Laboratory
Thomas Jefferson National Accelerator Facility	Lawrence Berkeley National Laboratory
Los Alamos National Laboratory	Oak Ridge National Laboratory

under contract DE-AC05-00OR22725
for the
U.S. DEPARTMENT OF ENERGY

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1. INTRODUCTION AND SCOPE

1.1 INTRODUCTION

This document describes the plan and procedure for installation, subsystem testing, conditioning and turnover of the various systems and facilities of the Spallation Neutron Source (SNS) accelerator. The plan covers the facilities from the time of the ready-for-equipment date/beneficial occupancy date through the start of operations.

The plan also addresses the infrastructure support and management systems required for the installation team to ensure successful completion of the accelerator installation and proper support for the Accelerator Readiness Review (ARR) and the Operational Readiness Review (ORR).

The Accelerator Systems Division (ASD) Installation Plan has been developed utilizing an approach described as “accelerator in a box.” This means, with certain constraints, it was assumed that all technical components are available on site when they are required. The plan is optimized for efficiency of the installation activities. The constraints considered in this approach were the SNS Major Project Milestones from the Integrated Project Schedule, Ready For Equipment/Beneficial Occupancy Dates negotiated with SNS Conventional Facilities, and commissioning dates and spans developed in the ASD Commissioning Plan. Component delivery dates were considered base on the currently available information. Additional detailed analysis of component delivery dates to determine if adjustments to current delivery schedules are required to support the detailed installation plan. In general, the component delivery dates support the ASD Installation Plan.

The ASD Installation Plan will be used as a management tool for active control of the installation activities. This means the plan will be revised to drive decisions, formalize changes, and communicate the evolution of the installation activities as more detail is developed.

1.2 SCOPE

This plan covers all activities required to install, complete acceptance testing, and officially turn over to Pre-Ops the SNS accelerator on time and within cost by December 2004. Systems covered by this plan are the accelerator systems consisting of the Front End (FE), linac—copper and superconducting linac, ring, and associated transfer lines and global controls. Specifically, installation is defined as all activities up to testing with beam. Commissioning is defined as testing with beam.

The scale of this effort is summarized as follows:

- Total cost of ASD technical systems—$440M
- Installation cost—$30M
- Installation labor—407,000 hours
- Accelerator Systems Division (ASD) technical staff—170,000 hours
- Davis-Bacon crafts—237,000 hours
- Installation span—33 months

See Fig. 1 for the SNS technical components global configuration.

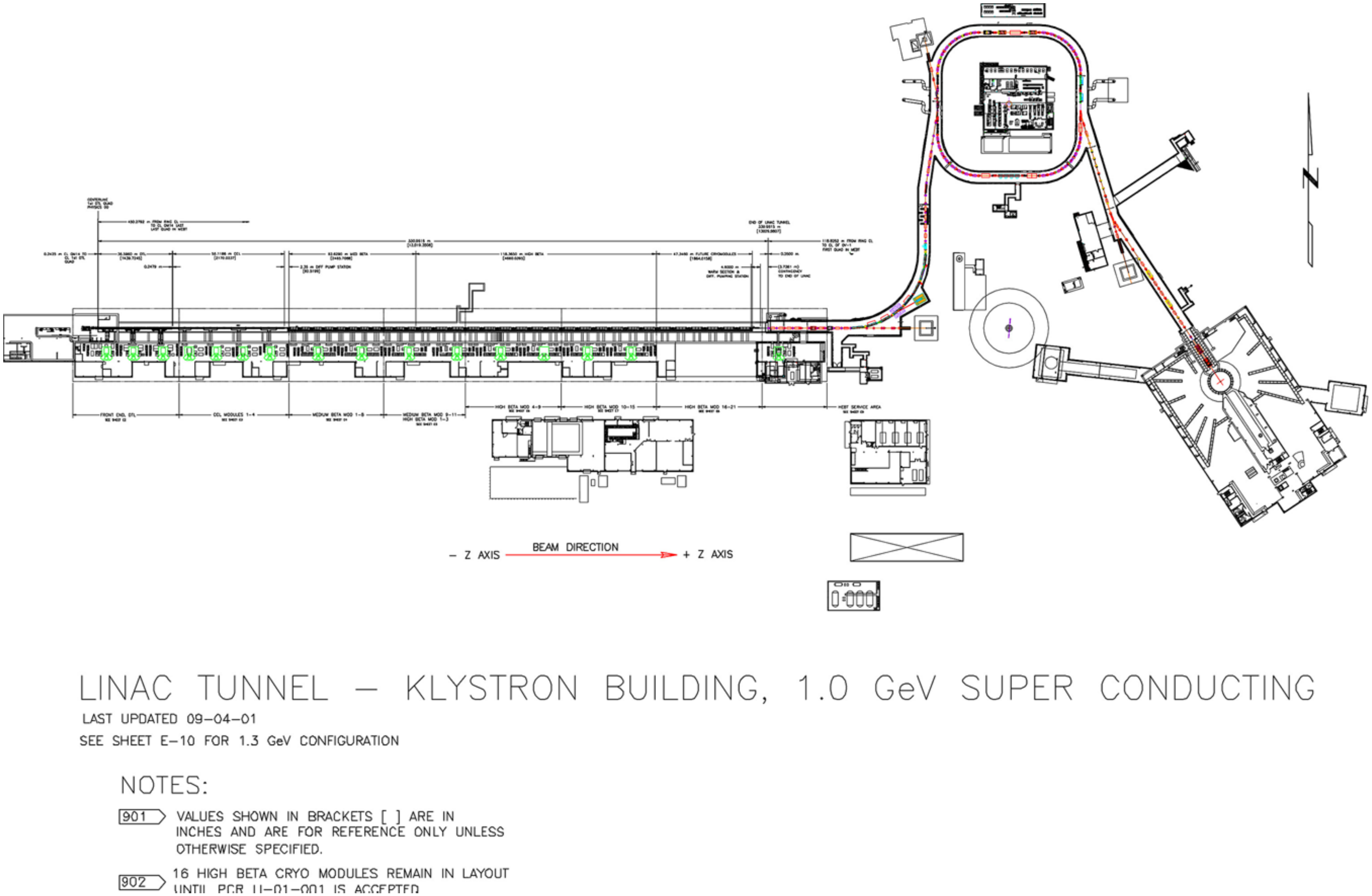


Fig. 1. SNS technical components global configuration.

1.3 MAJOR PROJECT MILESTONES

Emphasis in this plan is placed on producing a detailed plan that will meet the Major Project Milestones required to install the accelerator by December 2004. These milestones are considered Scope for this plan. The SNS project milestones are as follows:

Activity	Early Start	Early Finish	Note
Start line item project (complete)		01 Oct 98	PEP – 01 Oct 98
Award AE/CM contract (complete)		25 Nov 98	PEP – 28 Nov 98
EIS ROD (complete)		30 Jun 99	PEP – 30 Jun 98
CD-3 begin construction–site work		12 Nov 99	PEP – 12 Nov 99
Commissioning accelerator safety envelope approved		01 Aug 02	
Commissioning program plan approved		01 Aug 02	
Commissioning accelerator readiness review		15 Aug 02	
Complete FE subproject acceptance test		31 Dec 02	PEP – 5 Mar 03
Start 1st DTL tank (no. 3) installation	14 Jun 02	14 Aug 02	PEP – 30 Sep 02
DTL –beam available to CCL		01 Apr 04	
CCL installation (CCL1)	15 May 03	11 Jul 03	
CCL–install/condition CCL module 4		09 Feb 04	
Complete CCL subproject acceptance test	17 May 04	18 Aug 04	
Begin cryomodule installation	08 Jul 03		
Cryomodule installation	08 Jul 03	03 Aug 04	
Cryo transfer line installation	02 May 02	13 Feb 04	
Cryo system refrig. cooldown		01 Mar 04	
SC–systems test without beam	15 Apr 04	21 Oct 04	
SC–readiness assessment		30 Aug 04	
SC operational		21 Oct 04	
SC installation complete		30 Sept 04	
SC beam available to HEBT		21 Dec 04	
HEBT installation/test	14 Mar 03	26 Nov 04	
Start ring installation	02 Dec 02		PEP – 28 Mar 03
Ring installation	02 Dec 02	01 Dec 04	
HEBT & ring sys test with beam		21 Dec 04	
HEBT/ring beam/RTBT to xdump	22 Dec 04	17 Jun 05	PEP – 18 Nov 05
Complete subproject acceptance test HEBT & ring		17 Jun 05	
RTBT installation/test	02 Dec 02	04 Feb 05	
RTBT ready for beam		04 Feb 05	
Beam on target	01 Dec 05	30 Dec 05	

1.4 INTERFACE SCHEDULES

The ASD Installation interfaces with Conventional Facilities (CF) and ASD Commissioning to establish additional schedule constraints on the installation planning that are considered to be scope. The SNS CF Milestones, which identify Ready for Equipment (RFE) and Beneficial Occupancy Dates (BOD), are shown in Fig. 2. These CF dates determine which acceleration installation can begin. Commissioning start dates are also a constraint on accelerator installation. Those dates are shown in Fig. 3.

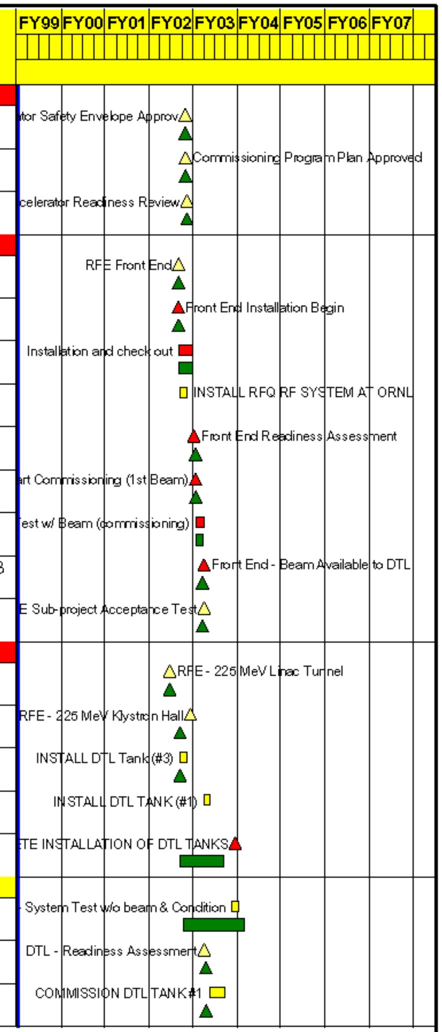
These two sets of schedule interface dates are tracked and negotiated on a continuous basis to ensure the viability of the ASD Installation Plan.

WBS	Description	R193 IPS Baseline BOD Date	R193 IPS Baseline RFE Date	Sept 30,2001 Revised Baseline update	AE/CM Current BOD Forecast	AE/CM Current RFE Forecast	PEP Date
18000	Milestone Level: 1 DOE HQ						
18302	BO-1000 MeV Linac Tunnel (1056 LF)	2-Jan-03			2-Dec-02		30-Apr-03
18306	BO-Ring Tunnel	8-May-03			20-Mar-03		1-Aug-03
18000	Milestone Level: 2 DOE ORO						
18100	Construction Complete (Complete landscaping)	30-Jun-05			30-Jun-05		30-Nov-05
18301	BO-Front End Building	4-Sep-02	3-Jun-02	14-Oct-02	14-Oct-02	14-May-02	31-Dec-02
18307	BO-Target Building (Begin Hot Cell Equip Install)	1-Jul-03			01-Jul-03		
18307	BO-Target Building Completion	6-Aug-04			6-Aug-04		31-Dec-04
18000	Milestone Level: 3 Project Office						
18100	Site Layout and Optimization Complete	1-Mar-01			3/1/2001 (A)		
18301	Start Construction FE Building	4-Sep-01			5/14/01 (A)		
18302	Start Construction Linac Tunnel	4-Sep-01			6/6/01 (A)		
18302	BO - 225MeV Linac Tunnel	9-Oct-02	29-Mar-02	10/14/02	14-Oct-02	29-Mar-02	
18302	BO - 600 MeV Linac Tunnel (612 LF)	4-Nov-02			14-Oct-02		
18303	Start Construction Klystron Hall	4-Sep-01			9/28/01 (A)		
18303	BO -225 MeV Klystron Building	2-Oct-02	17-Jun-02	9/9/2002 RFE 10/14/02 BOD	14-Oct-02	09-Sep-02	
18303	BO - 1000 MeV Klystron Building (994 LF)	14-Jan-03			02-Dec-02		
18303	HEBT Truck Entrance Available			1/15/03	02-Jan-03		
18304	Start Construction of HEBT Tunnel	1-Oct-01		11/30/01	27-Nov-01		
18304	BO - HEBT Tunnel	10-Apr-03			31-Mar-03		
18305	Start Construction of Ring Tunnel	1-Nov-01		11/30/01	29-Nov-01		
18306	Start Construction RTBT Tunnel	2-Oct-01		12/6/01	06-Dec-01		
18306	BO - RTBT Tunnel	29-Aug-03			06-Feb-03		
18308	BO - Ring Service Building	9-May-03			6-May-03		
18309	BO - RTBT Service Building	30-Apr-03			8-May-03		
18310	Start Construction of Dumps	1-Aug-01		3/1/02	01-Mar-02		
18310	BO-Extraction Dump	1-Dec-03			25-Mar-03		
18310	BO-Injection Dump	2-Dec-03			24-Apr-03		
18311	IPL-BO Central Utilities Building	6-Nov-02		06-Nov-02	11-Nov-02		
18314	Start Construction CLO	1-Oct-02			4-Feb-03		
18301	BO - Front End Control Room	30-Sep-02			30-Sep-02		
18314	BO - Central Lab and Office Bldg	30-Jun-04			30-Jun-04		
18000	Milestone Level: 4 Tony Chargin						
18303	BO - HEBT Service Building	28-Mar-03			12-Mar-03		
18316	CHL Building	15-Aug-02	1-Apr-02	7/3/02 RFE 9/24/2002 BOD	24-Sep-02	3-Jul-02	
18317	RF Building	15-Aug-02		24-Sep-02	24-Sep-02		
18201	Complete Site Utilities	6-Mar-03			17-Feb-03		
18204	Complete Early Construction Package	26-Jan-01			1/26/01 (A)		
18204	Complete Final Site Grading	30-Nov-04			30-Mar-04		
18307	IPL-Begin Installation of Bulk Shielding and Liner	3-Mar-03			1-Mar-03		1-Jun-03
18307	IPL- Begin Hot Cell Equipment Installation	1-Jul-03			1-Jul-03		
18307	IPL-Begin Target Building for RTBT Installation	5-Mar-02			5-Mar-02		
18307	IPL-BeginTarget Building Basement Installation	3-Mar-03			3-Mar-03		
18307	IPL-Target Cell Concrete Shielding Complete	1-Jul-03			3-Mar-03		
18307	IPL-BO for Scattering Instrument Installation – Target Building	4-Jun-04			4-Jun-04		
18310	IPL-BO Linac Dump	2-Jun-03			9-Dec-02		
18310	Start Construction Utilities Building	4-Sep-01		28-Nov-01	12-Nov-01		
18501	Complete CF Instrument and Control	20-Mar-03			20-Mar-03		
18901	IPL-Partial Site Services Ready for Commissioning	4-Sep-02		14-Oct-02	14-Oct-02		
18000	Milestone Level: 5 Jim Lawson						
18301	Complete Design FE/Linac/Klystron Facilities	6-Jun-01			6/27/2001 (A)		
18305	Complete Design Ring Facilities	2-Jul-01			8/1/2001 (A)		
18307	Complete Design Target Building	28-Sep-01		26-Oct-01	26-Oct-01		
18310	Complete Design of Dumps	1-May-01			8/3/2001(A)		
18311	Complete Design Utility Building	1-Jun-01			7/13/2001 (A)		
18314	Complete Design CLO	30-Mar-01			5/15/2001 (A)		
18401	TVA Start Design of SNS Substation	2-Feb-01			3/12/2001 (A)		
18401	TVA Start Construction of Substation	15-Oct-01			15-Oct-01		
18401	Complete Construction of Substation	6-Mar-03			17-Feb-03		
18203	Main Exhaust Stack Operational	3-Sep-02		13-Mar-03	14-Jan-03		
18307	IPL- TG to CF- Basement Drain Tnk Rdy for	14-Sep-01		03-Dec-01	03-Dec-01		
18307	IPL- TG to CF- Bk Shield Drn Line Rdy for Inst	4-Jan-02			04-Jan-02		
18307	IPL- TG to CF- Util Sleeves Rdy for Install	20-Dec-02			20-Dec-02		
18307	IPL- TG to CF B Shld Rdy for Chp Cvty Out	13-Aug-02			13-Aug-02		
18307	IPL-CF to TG- H2 Util Rm & Vent Stack Rdy	28-Jan-03			28-Jan-03		
18307	IPL-CF to TG- Target Cell Access	30-Jun-03			30-Jun-03		
18307	IPL-CF to TG- Bldg Rdy for Mockup Test	31-Dec-03			31-Dec-03		
18310	IPL -CF to TG- LD Ready for Block Shielding	26-Mar-02		09-Jul-02	09-Jul-02		
18310	IPL -CF to TG- RID Ready for Block Shielding	31-May-02			03-May-02		
18310	IPL -TG to CF -LD Block Shield Install Complete	2-Jul-02		12-Nov-02	12-Nov-02		
18310	IPL -CF to TG- RED Ready for Block Shielding	28-Mar-02		11-Sep-02	11-Sep-02		
18310	IPL -TG to CF -RID Block Shield Install Complete	10-Oct-02			10-Oct-02		
18310	IPL -TG to CF -RED Block Shield Install Complete	5-Jul-02		21-Jan-03	21-Jan-03		

Bold outline=late.
Shaded=revised data from previous reporting period.
(A)=actual date.

Fig. 2. SNS CF Milestones (Sept. 30, 2001)

Activity ID	RESP	PEP ID	Activity Description	Proposed IPS ES	Proposed IPS EF	Baseline IPS ES	Baseline IPS EF	PEP Date
Project Support								
PS150	PS		Commissioning Accelerator Safety Envelope Approv		01AUG02*		01AUG02*	
PS155	PS		Commissioning Program Plan Approved		01AUG02		01AUG02	
PS160	PS		Commissioning Accelerator Readiness Review		15AUG02		15AUG02	
Front End								
FERFE	CF		RFE Front End		03JUN02*		03JUN02	
FEIN05	AS	2-06	Front End Installation Begin	03JUN02*		07JUN02		30SEP02
FEIN	AS		Installation and check out	03JUN02	25SEP02	07JUN02	01OCT02	
FETE10	AS		INSTALL RFQ RF SYSTEM AT ORNL	14JUN02*	15AUG02			
FETE5	AS		Front End Readiness Assessment		15OCT02		30OCT02	
FE110	AS		Front End - Start Commissioning (1st Beam)	29OCT02		01NOV02		
FE115	AS		Front End - System Test w/ Beam (commissioning)	29OCT02	31DEC02	01NOV02	26DEC02	
FE120	AS	1B-06	Front End - Beam Available to DTL		31DEC02		26DEC02	31MAR03
FE125	AS		Complete FE Sub-project Acceptance Test		31DEC02		26DEC02	
Linac - DTL								
DTLRFE	CF		RFE - 225 MeV Linac Tunnel	29MAR02*		29MAR02		
DTKRFE	CF		RFE - 225 MeV Klystron Hall	09SEP02*		17JUN02		
DTL045	AS	2-09	INSTALL DTL Tank (#3)	14JUN02	14AUG02	17JUN02		30SEP02
DTLINK31	AS		INSTALL DTL TANK (#1)	09JAN03	20FEB03			
DTLIN	AS		COMPLETE INSTALLATION OF DTL TANKS		17SEP03*	17JUN02	17JUN03	
DTL Commissioning								
DTL080	AS		DTL - System Test w/o beam & Condition	20AUG03	15OCT03	24JUL02*	05DEC03	
DTL090	AS		DTL - Readiness Assessment		31DEC02		17JAN03	
DTL100	AS		COMMISSION DTL TANK #1	21FEB03	30JUN03	21JAN03		



Start Date	01OCT97
Finish Date	01JUL06
Data Date	01OCT98
Run Date	25OCT01 10:17

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Proposed
Baseline
Progress Bar
Critical Activity

08R3

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Integrated Project Schedule (IPS-08)
DRAFT CREATED 10/24/01

Installation & Comm.

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Fig. 3. Interface and Commissioning Milestones.

Activity ID	RESP	PEP ID	Activity Description	Proposed IPS ES	Proposed IPS EF	Baseline IPS ES	Baseline IPS EF	PEP Date
DTL 130	AS		COMMISSION DTL TANKS #1-#6	16OCT03	09APR04			
DTL 120	AS		DTL - Beam Available to CCL		09APR04		01APR04	
Linac - CCL								
CCLFB90	AS		INSTALL FIRST CCL RF SYSTEM AT ORNL		31DEC02*			
CCLFB110	AS		INSTALL FIRST CCL MODULE (#1)	15MAY03	11JUL03			
CCLFB120	AS		INSTALLATION OF LAST CCL MODULE COMPLETE (#4)		09FEB04			
CCL Commissioning								
CCL230	AS		CCL Readiness Assessment		09APR04		08JUN04	
CCL235	AS		CCL - Start System Test with Beam (1st Beam)	25MAY04		09JUN04		
CCL240	AS		CCL - System Test with Beam (Commissioning)	25MAY04	18AUG04	09JUN04	20AUG04	
CCL255	AS		CCL Beam Available to SC Linac		18AUG04		20AUG04	
CCL265	AS		Complete Subproject Accept. Test		18AUG04		20AUG04	
Linac - SC								
SC								
CCL351	SL		Start Shipping Cryomodules	19NOV02*	27NOV02	02JAN03*		
CCL353	AS		Begin Cryomodule Installation	08JUL03*		02SEP03*		
SC23	AS		Cryomodule Installation	08JUL03	03AUG04	02SEP03	30SEP04	
SC40	AS		Install and condition LowB CM 1-4	19AUG04	30SEP04	15AUG02		
SC30	AS		SC Installation Complete		30SEP04		30SEP04	
Refrigerator								
SCRFE	CF		RFE - Cryo Building		05JUL02*		01APR02	
SC25	AS		Cryo Refrigerator installation	18SEP02*	30DEC03	19APR02	22OCT03	
SC35	AS		Cryo System Refrig. Cooldown		01MAR04	23OCT03	01MAR04	
Transfer Lines								
SC65	AS		Cryo Transfer Line Installation	02MAY02	13FEB04	29APR02	10FEB04	
LANL Warm Items								
LAN21	AS		INSTALL FIRST SC 805RF SYSTEM AT ORNL		29JAN03			
CCL343	CF		BOD - 1000 MeV Klystron Building	14JAN03		14JAN03		
LAMS								
CCL329			BOD - HEBT Service Building	28MAR03		28MAR03		

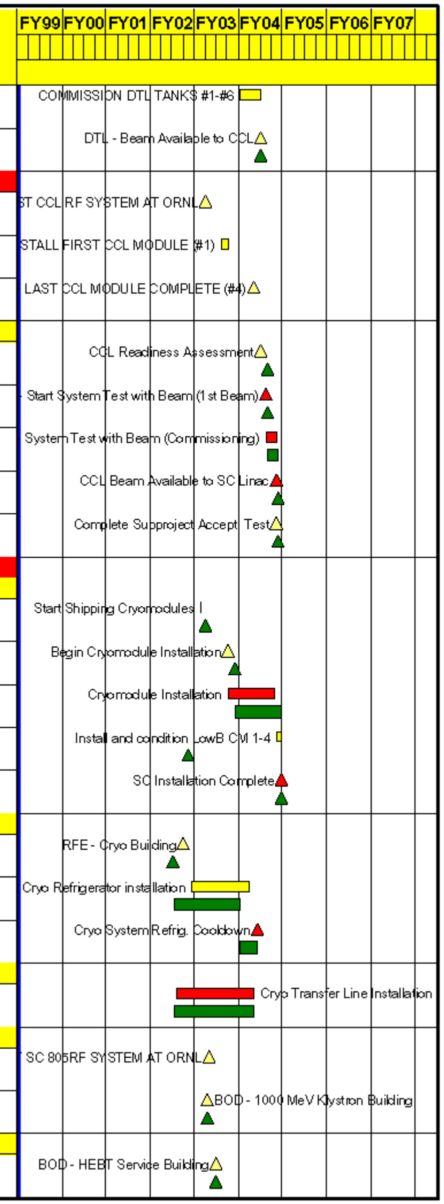

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Fig. 3. Interface and Commissioning Milestones (continued).

Activity ID	RESP	PEP ID	Activity Description	Proposed IPS ES	Proposed IPS EF	Baseline IPS ES	Baseline IPS EF	PEP Date
CCL327			BOD - HEBT Tunnel	10APR03		10APR03		
LAMSIN			Installation / Testing	29SEP03	29DEC03	29SEP03	29DEC03	
Linac Dump								
CCL330	CF		BOD - Linac Tuning Dump	02JUN03		02JUN03		
LDIN	TG		Installation / Testing	21NOV03*	30AUG04	15MAR02	25AUG04	
SC Commissioning								
SC300	AS		SC Readiness Assessment		30AUG04		27SEP04	
SC310	AS		SC - System Test without Beam (Cooldown & Cond.)	15APR04	21OCT04	17JUN04	30SEP04	
SC315	AS		SRF Operational		21OCT04		30SEP04	
SC320	AS		SC - Start System Test with Beam (1st Beam)	01OCT04		01OCT04		
SC325	AS		SC - System Test with Beam (Commissioning)	01OCT04	21DEC04	01OCT04	21DEC04	
SC330	AS	1B-09	SC Beam Available To HEBT		21DEC04		21DEC04	31MAY05
SC340	AS		Complete Subproject Accept. Test		21DEC04		21DEC04	
Ring - HEBT to Ring								
HEBT & Ring								
RINGIN5	AS	2-12	Start Ring Installation	02DEC02*		02DEC02*		28MAR03
HEBT532	CF		BOD - Ring Service Building	09MAY03		09MAY03		
RINGIN	AS		Installation & Testing	02DEC02	01DEC04	02DEC02	01DEC04	
Injection & Extraction Dumps								
HEBTCA	RI		HEBT Cavity ready for Installation	01APR03*		01APR03*		
HEBTCA1	AS		HEBT Cavity Installation Complete		01JUL03*		01JUL03*	
EDUMP526	CF		BOD - Extraction Dump	01DEC03		01DEC03		
IDUMP508	CF		BOD - Injection Dump	01DEC03		02DEC03		
TGIEDIN	TG		Installation / Test	14MAR03*	26NOV03	14MAR03	21DEC04	
Commissioning								
HEBT157	AS		HEBT & Ring Readiness Assessment		22OCT04		21DEC04	
HEBT170	AS		HEBT & Ring - Start System Test with Beam (1st)		21DEC04		21DEC04	
HEBT290	AS		HEBT & Ring - Sys Test with Beam (commissioning)	22DEC04	17JUN05	22DEC04	17JUN05	
HEBT295	AS	1B-10	HEBT & Ring - Beam Available to RTBT & XDump		17JUN05		17JUN05	18NOV05

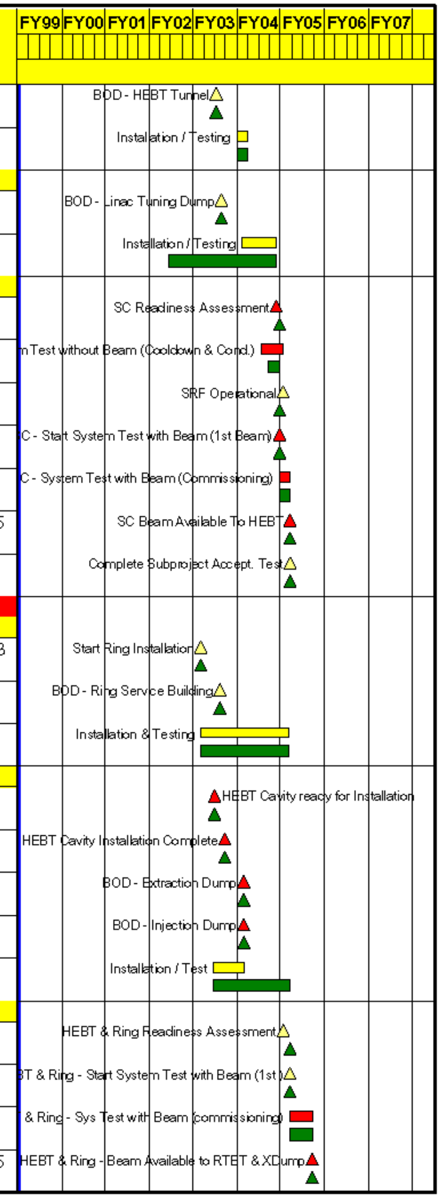


Fig. 3. Interface and Commissioning Milestones (continued).

Activity ID	RESP	PEP ID	Activity Description	Proposed IPS ES	Proposed IPS EF	Baseline IPS ES	Baseline IPS EF	PEP Date
HEBT305	AS		Complete subproject acceptance Test HEBT & Ring		17JUN05		17JUN05	
Target - RTBT to Target								
Target								
TARGIN5	TG	2-15	Start Target Installation	04MAR03		04MAR03		01JUN03
RTBTRFE1	TG		Target Building ready for Bulk Shielding install		03MAR03*		03MAR03*	
TARGIN	TG		Installation / Integrated Testing	04MAR03	30SEP05	04MAR03	30SEP05	
RTBTRFE2	TG		Target Bldg ready for Hot Cell Equip. Instal		01JUL03*		01JUL03*	
RTBT308	TG		Start Hot Cell Equipment Install	02JUL03		02JUL03		
RTBT								
RTBT302	RI		BOD - RTBT Service Building	30APR03		30APR03		
RTBTIN	RI		Installation / Test	02DEC02	04FEB05	30APR03	30JUN05	
RTBT410	RI		RTBT Readiness Assessment	02MAY05	30JUN05	02MAY05	30JUN05	
Commissioning								
RTBT337	TG		Target & RTBT Initial Sub-Project Accept Tests	01DEC05	30DEC05	01DEC05	30DEC05	
RTBT342	TG		Complete Sub-Project Acceptance Tests		30DEC05		30DEC05	
RTBT411	TG		Beam on Target		01DEC05		01DEC05	
RTBT315	TG	1A-04	Target Commissioning	01DEC05	30DEC05	01DEC05	30DEC05	01MAY06
Pre-Operations								
OPCO2	OP		Pre-Operations/Commissioning	01OCT01*	30JUN06	01OCT01*	30JUN06	
PS130	ALL	0-4	CD-4 - Project Complete		30DEC05		30DEC05	30JUN06
PS170	ALL	1A-05	Finish Project Acceptance Test		30DEC05		30DEC05	30JUN06
OPCO7	ALL		Low Power Testing	03JAN06	30MAR06	03JAN06	30MAR06	
PS135	ALL		CONSTRUCTION FLOAT	03JAN06	30JUN06	03JAN06	30JUN06	
OPCO8	ALL		Accelerator Readiness Review		30MAR06		30MAR06	
PS165	ALL		Operational Readiness Review		01JUL06*		01JUL06*	
Instrument Systems								
EXPEIN5	IS	2-17	Start Instrument Installation	02SEP03		02SEP03		31DEC03
EXPEIN	IS		Installation	02SEP03	30DEC05	02SEP03	30DEC05	
EXPEIN10	IS	2-18	Complete Instrument Sys. Sub-proj. Accept. Test		30DEC05		30DEC05	30JUN06

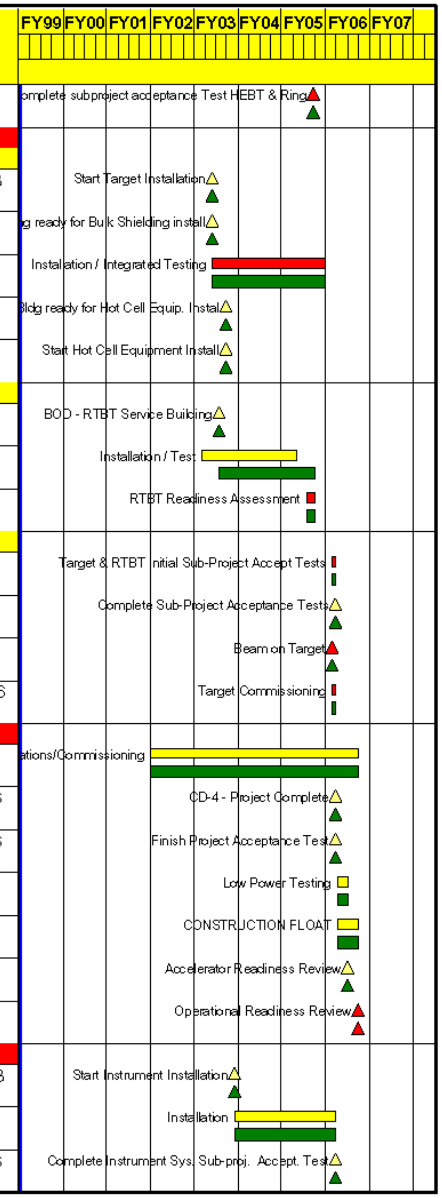
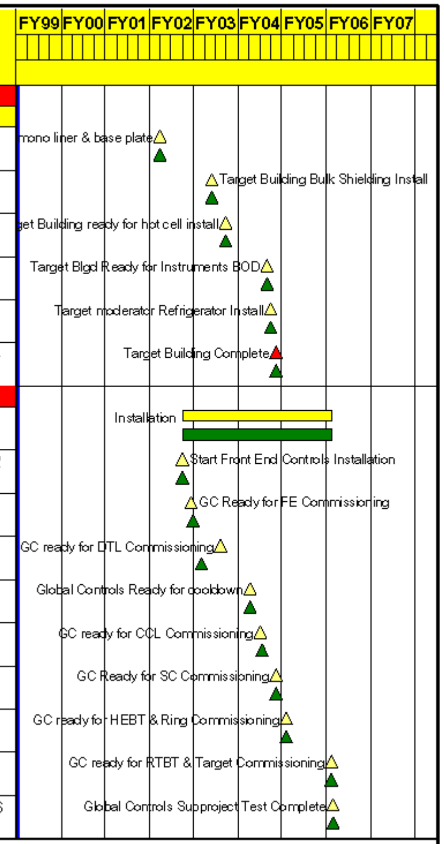


Fig. 3. Interface and Commissioning Milestones (continued).

Activity ID	RESP	PEP ID	Activity Description	Proposed IPS ES	Proposed IPS EF	Baseline IPS ES	Baseline IPS EF	PEP Date
Conventional Facilities								
Target Building								
CFTG	CF		Target Blding Ready for mono liner & base plate	02JAN02*		02JAN02*		
CFTGRFE1	CF		Target Building Bulk Shielding Install		03MAR03*		03MAR03*	
CFTGRFE2	CF		Target Building ready for hot cell install		01JUL03*		01JUL03*	
CFTGBOD3	CF		Target Blgd Ready for Instruments BOD	04JUN04*		04JUN04*		
CFTGRFE3	CF		Target moderator Refrigerator Install		05JUL04*		05JUL04*	
CFTG1	CF	2-23	Target Building Complete	06AUG04		06AUG04		31DEC04
Global Controls								
CTIN	CO		Installation	28JUN02	09NOV05	08JUL02	15NOV05	
CTIN15	CO	2-26	Start Front End Controls Installation	28JUN02		08JUL02		31OCT02
CTIN02	CO		GC Ready for FE Commissioning	17SEP02		20SEP02		
CTIN04	CO		GC ready for DTL Commissioning	19MAY03		04DEC02		
CTIN18	CO		Global Controls Ready for cooldown		16JAN04		16JAN04	
CTIN06	CO		GC ready for CCL Commissioning	12APR04		27APR04		
CTIN08	CO		GC Ready for SC Commissioning	19AUG04		19AUG04		
CTIN10	CO		GC ready for HEBT & Ring Commissioning	08NOV04		08NOV04		
CTIN12	CO		GC ready for RTBT & Target Commissioning	15NOV05		15NOV05		
CTIN5	CO	2-27	Global Controls Subproject Test Complete		30NOV05		30NOV05	01MAY06



Sheet 5 of 5

Fig. 3. Interface and Commissioning Milestones (continued).

2. INSTALLATION MANAGEMENT

2.1 ORGANIZATION

Installation of the SNS accelerator requires detailed planning and close coordination of field activities. With design and procurement located in six partner laboratories and technical components being fabricated at numerous locations, disciplined execution of the detailed plan is essential to maintain the project cost and schedule baseline. The distributed decision-making authority across the project places a premium on the installation field team having a detailed plan through which they can quickly react to changing conditions. Resource leveling of ASD technical staff and Davis-Bacon crafts will be required to control costs and maintain schedule.

The ASD has been reorganized into 11 groups. That organization is shown in Fig. 4. One of the issues addressed in this reorganization was to focus on installation through the creation of an Installation Services Group. This group been established as a close matrix team. Each of the ASD technical groups will provide technical leads and specialists to supervise work in the field. Group leaders will retain control of the costs, schedule, and technical decisions as they evolve. The organization of the ASD Installation Services Group is shown in Fig. 5. The Installation Services Group will provide day-to-day and weekly coordination of overall installation activities. This group also will ensure efficient use of touch labor; coordinate interfaces with external support facilities, transportation, communications, stock room, tool room; and provide machine shop support.

2.2 RESPONSIBILITIES

Installation of the SNS accelerator on a “green” site by a newly organized installation team requires more detailed definition of individual roles and responsibilities than at an established accelerator laboratory with recent construction project experience. These detailed descriptions have been developed in accordance with the matrix installation organization described in Section 2.1.

In addition to these position descriptions, an initial assignment of specific SNS personnel to installation technical lead positions has been issued for all subsystems (Fig. 6). These assignments will be updated as the installation team matures.

2.2.1 Group Leaders

Group leaders have the following responsibilities:

- Ensuring compliance of the group with environment, safety, and health (ES&H) requirements.
- Ensuring the quality and cost/schedule performance of installation.
- Ensuring that all required documentation, including documentation submitted by partner laboratories, is complete, accurate, and on schedule.
- Coordinating tasks and/or resources between groups as required.
- Managing the installation budget of the assigned subsystems.
- Ensuring installation cost performance.
- Approving and/or developing work-arounds or field engineering changes as needed.
- Monitoring resource leveling.
- Reporting on the status of installation; receiving, acceptance, testing, and storage (RATS); and partner lab and vendor deliveries.

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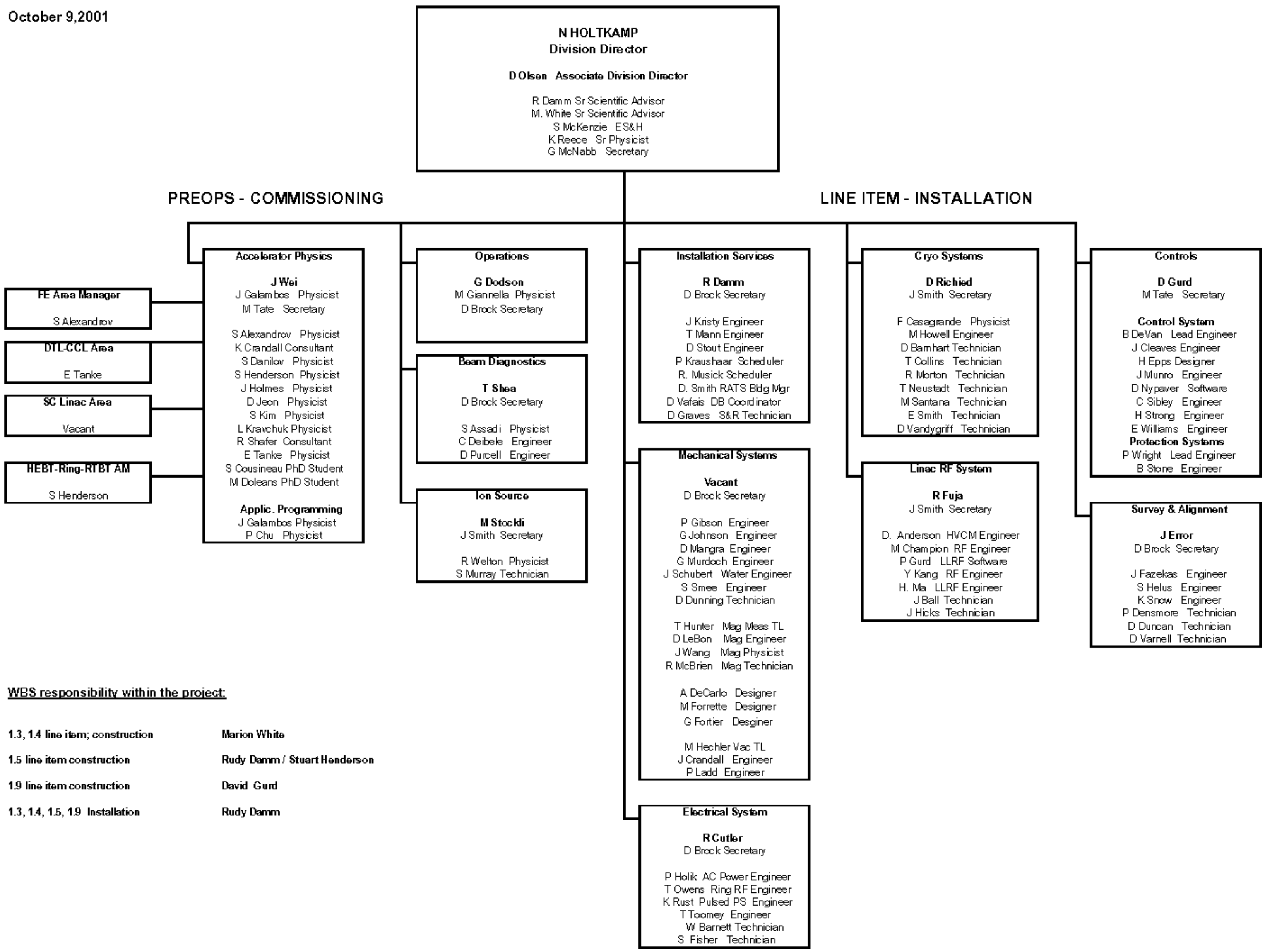


WBS responsibility within the project:

1.3, 1.4 line item; construction	Marion White
1.5 line item construction	Rudy Damm / Stuart Henderson
1.9 line item construction	David Gurd
1.3, 1.4, 1.5, 1.9 Installation	Rudy Damm

Fig. 4. SNS ASD Organization Chart

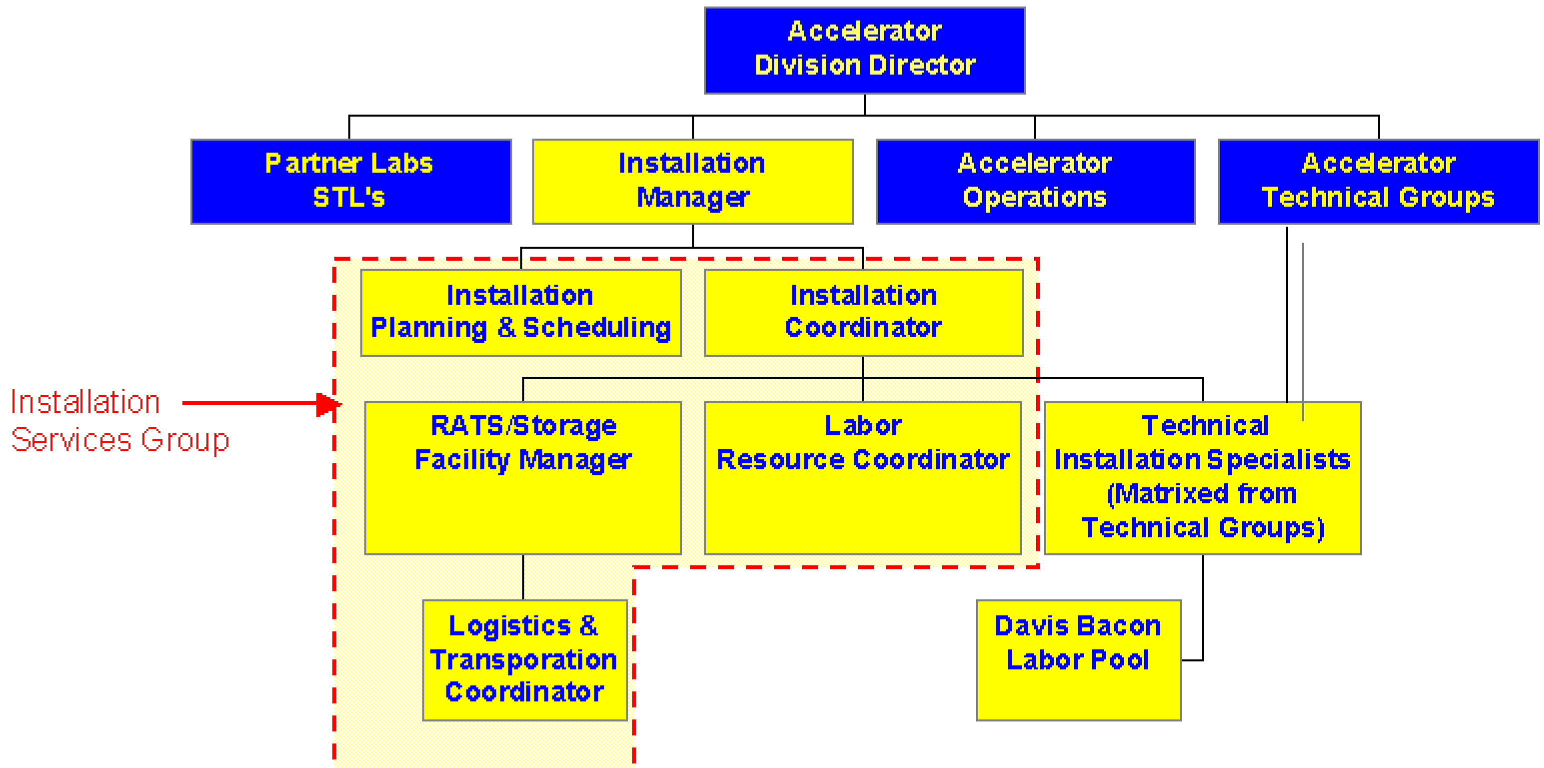


Fig. 5. Installation Services Group organization.

	Overall Scientific Coord	Cable Systems	Electrical Utilities	Mechanical Utilities	Magnets	Power Supplies	RF	Instrumentation & Beam Diagnostics	Controls	Alignmen	Conventional Facilities	Ops/ Physics	Mechanical	Vacuum
Front End	Aleksandrov	Cleaves	Holik	Schubert	Hunter	Cutler	Fuja	Shea	Gurd	Error	McLaughlin	Dodson	Gibson/Hecheler	Hechler
DTL	Tanke	Cleaves	Holik	Schubert	Hunter	Culter	Fuja	Shea	Gurd	Error	McLaughlin	Dodson	Johnson	Hechler
CCL	Tanke	Cleaves	Holik	Schubert	Hunter	Cutler	Fuja	Shea	Gurd	Error	McLaughlin	Dodson	Johnson	Hechler
SCL	White	Cleaves	Holik	Schubert	Hunter	Cutler	Fuja	Shea	Gurd	Error	McLaughlin	Dodson	Stout	Hechler
Warm Piping	Richied	Cleaves	Holik	Schubert				Vandygriff	Gurd	Error	Stellern			
& Transfer Lines											McLaughlin		Richied	Richied
CHL	Richied	Cleaves	Holik	Schubert		Richied		Vandygriff	Strong	Error	Stellern	Dodson	Richied	Richied
	Casagrande					Casagrande							Howell	Hechler
RF Test Bldg	Fuja	Cleaves	Holik	Schubert		Fuja	Fuja	Fuja	Gurd	Error	Stellern		Mech-NH1-RF	Hechler
HEBT Tunnel	Henderson	Cleaves	Holik	Schubert	Hunter		Fuja - HEBT RF	Shea	Gurd	Error	Stellern	Dodson	Murdoch	Hechler
Ring Tunnel	Henderson	Cleaves	Holik	Schubert	Hunter		Cutler	Shea	Gurd	Error	Stellern	Dodson	Murdoch	Hechler
RTBT Tunnel	Henderson	Cleaves	Holik	Schubert	Hunter			Shea	Gurd	Error	Stellern	Dodson	Murdoch	Hechler
Kylstron Bldg.	Fuja	Cleaves	Holik	Schubert		Cutler	Fuja	Shea	Gurd	Error	McLaughlin	Dodson	Mech-NH1-RF	Hechler
HEBT Service	Henderson	Cleaves	Holik	Schubert		Cutler	Fuja - HEBT RF	Shea	Gurd	Error	Stellern	Dodson	Mech-NH2-PS	Hechler
	Cutler													
Ring Service	Henderson	Cleaves	Holik	Schubert		Cutler		Shea	Gurd	Error	Stellern	Dodson	Mech-NH2-PS	Hechler
	Cutler													
RTBT Service	Henderson	Cleaves	Holik	Schubert		Cutler		Shea	Gurd	Error	Stellern	Dodson	Mech-NH2-PS	Hechler
	Cutler													
Beam Dumps	Reece	XFD		Schubert					Gurd	Error	Dean	Dodson	Murdoch	Hechler
	XFD												XFD	XFD
Overall Instl Co	Kristy	Kristy	Kristy	Kristy	Kristy	Kristy	Kristy	Kristy	Kristy	Kristy	Kristy	Kristy	Kristy	Kristy

Fig. 6. Initial assignment of personnel assigned to the SNS Installation group.

- Working with the scheduler to optimize the installation schedule.
- Attending weekly ASD installation coordination meetings.
- Developing equipment testing procedures and overseeing their performance.

2.2.2 Senior/Lead Installation Engineers

Senior/lead installation engineers have the following responsibilities:

- Performing individual work assignments in accordance with ES&H requirements.
- Verifying the quality of installation (ACLs).
- Completing the transfer of documentation from partner laboratories.
- Preparing required installation documentation.
- Directing tests of installed components and systems.
- Approving Davis Bacon labor hours and Materials & Supplies expenditures.
- Becoming fully informed on the overall status of all assigned components before installation.
- Reporting on the installation status.
- Assisting in resource leveling.
- Leading installation planning and scheduling of assigned systems.
- Assisting the scheduler in the optimization of installation activities.
- Recommending work–arounds or field engineering changes to the group leader.
- Attending daily ASD installation coordination meetings.

2.2.3 Installation Technical Specialists

Installation technical specialists have the following responsibilities:

- Performing individual work assignments in accordance with ES&H requirements.
- Performing installation of non-DB technical components.
- Providing close supervision of DB installation labor.
- Ensuring that DB labor is properly trained.
- Assisting with testing of installed components and systems.
- Assisting with resource leveling.
- Assisting with task planning and scheduling.
- Staying informed about the status of components in storage and arriving at the RATS building.
- Implementing and documenting field engineering changes.

2.2.4 Installation Manager

The Installation manager has the following responsibilities:

- Performing individual work assignments in accordance with ES&H requirements.
- Managing the Installation Services Group.
- Proving high level data collection and decision making for installation activities
- Overseeing group leaders and senior installation engineers for installation activities.
- Chairing the weekly installation “rolling schedule” meeting with group leaders.
- Tracking weekly installation costs and distributing cost reports to group leaders.
- Supporting group leaders in determining appropriate documentation for installation.
- Tracking inspection discrepancy reports (IDRs) and ensuring their timely resolution.
- Approving acceptance criteria listings (ACLs) before turnover of subsystems to operations.
- Serving as a point of contact for infrastructure support to installation (i.e., shops, stock room, tool room, transportation, and communications).

2.2.5 Installation Planning And Scheduling Engineer

- Prepare detailed resource loaded installation schedule.
- Prepare recommendations for resource leveling.
- Perform contingency analyses of different installation scenarios.
- Update detailed installation schedule as required by actual conditions in the field.
- Collect and analyze weekly installation performance.

2.2.6 Installation Coordinator

The Installation coordinator has the following responsibilities:

- Performing individual work assignments in accordance with ES&H requirements.
- Coordinating technical and craft installation labor forces.
- Overseeing resource leveling.
- Overseeing installation technical specialists.
- Overseeing short- and long-term planning.
- Overseeing the ASD Davis-Bacon level-of-effort (LOE) subcontract.
- Providing signature authority for all DB LOE subcontract service request orders (SROs).
- Approving all DB LOE subcontract invoices.
- Leading the daily ASD installation coordination meeting.

2.2.7 Labor Resource Coordinator

The labor resource coordinator has the following responsibilities:

- Ensuring installation subcontractor compliance with the architect-engineer/construction manager (AE/CM) ES&H Plan.
- Administering the DB LOE subcontract and any fixed-price installation contracts.
- Ensuring that subcontracts are in compliance with site safety rules.
- Auditing the quality of installation subcontractors.
- Issuing and logging of all LOE subcontractors SROs.
- Auditing the accuracy of LOE subcontractors' daily time, material, and equipment invoices.
- Tracking subcontractor expenditures and notifying the installation coordinator of potential over runs.
- Assisting in Davis-Bacon craft resource leveling.
- Handling disputes among Davis-Bacon crafts personnel.
- Assisting in identifying scheduling conflicts between subcontractors.
- Attending the ASD daily installation coordination meeting.

2.3 PROJECT TECHNICAL BASELINE

The *SNS Parameters List*, SNS 100000000-PL0001-R05, and the *SNS WBS Descriptors*, SNS-100000000-BL0002-R04, constitute the formal technical baseline for SNS.

In addition to the official SNS Technical Base Line documents referenced above, the partner laboratories, under the *SNS Accelerator Turnover Plan*, SNS-1000000000-PN0001-R00 (Attachment A), have agreed to provide additional technical base line documentation, which is critical to the ASD Installation activities. In general, this addition documentation is as follows:

- As-Built Drawings
- Native CAD files

- Test Results/QA records (Traveler)
- Installation sketches and procedures
- Cabling drawings
- Vendor-supplied documentation (power supply operating manuals)

2.4 INSTALLATION DOCUMENTATION

It is ASD policy that the installation of all technical components, subsystems, systems, and the associated conditioning and testing without beam be performed in accordance with formal, signed documentation. It is the responsibility of ASD group leaders to implement this policy. Lead engineers will release documentation for use. Implementation of this requirement is described in Section 2.5.

It is recognized that some installation activities can be performed with less formal documentation. Determination of individual instances where this exception is applicable will be the decision of the Group Leader with the concurrence of the Installation Manager and the ASD Quality Assurance Representative (QAR). As a guide to making these decisions, Group Leaders should consider the quality assurance (QA) quality levels described in Section 4.2.

An essential element of the ASD Installation documentation is the creation and use of "travelers." "Travelers" are step-by-step descriptions of subsystem installation activities. Successfully completed installation activities are approved/initialed by the assigned Installation Technical Specialists. "Travelers" will identify all installation drawing specifications, procedures, and acceptance criteria listings (ACLs) required to complete the subsystem installation. The traveler package will provide the mechanism for collecting "as built" information as installation progresses. If the "as builts" are not included in the "traveler", the subsystem is not complete.

2.5 CONFIGURATION MANAGEMENT

The *SNS Configuration Management Plan,* SNS 1020102000-PC0002-R02, and *SNS Project Controls Manual*, SNS 102010200-PC0001-R03, are the governing documents for configuration control for ASD Installation. All ASD installation activities will be conducted in accordance with these project policies.

As defined in Section 2.4, it is ASD policy that all installation of technical components and subsystems, as well as their associated conditioning and testing without beam be performed in accordance with formal, signed documentation. In the environment of an accelerator installation where field changes are frequently necessary to make first-article hardware work, ASD Installation must implement a process to efficiently handle and control these changes.

The following process is proposed:

The initial release of all installation packages (i.e., drawings, specifications, procedures) will be transmitted with an SNS Accelerator Division—Document Transmittal form signed by the appropriate Group Leader (Fig. 7). After that initial formal release, up to six field changes may be made to the documents through sketches and formal logbook entries. After the sixth change, a Document Change Notice per the *Project Controls Manual* will be initiated and the document formally revised (Fig. 8).

The exception to this field configuration control policy is ES&H. If a document change affects an ES&H requirement or changes the risk level inherent in a design or its implementation, the original documentation will be revised and formally reviewed and approved before its re-release.

2.6 INSTALLATION COORDINATION

Installation coordination will be accomplished through daily morning meetings chaired by the Installation Coordinator and attended by the lead engineers. Weekly meetings will be held each Friday chaired by the Installation Manager and attended by group leaders. This weekly meeting will focus on maintaining a two-week (rolling) schedule.

SNS Accelerator Division – Document Transmittal

Title:

Date	Transmittal Number	
System / Building		WBS No.(s)

Subject:

Description of Change:

PCR Required: __ yes / __ no

Originator: _______________

Authorized by: ______________

Approved by (Division Office): ______________

DISTRIBUTION					
Function	**Name**	**E-mail**	**Purpose**	**Dist. Method**	**Special Instructions**

LIST OF TRANSMITTED DOCUMENTS OR FILES, AND LOCATIONS IF POSTED.

Title/Description and Number	File Name or Location (if posted)

PURPOSE CODES: Documents are transmitted or available for one of these purposes or as listed in the Special Instructions column.

A	Approved for Use*	SA	Submitted for Approval or Concurrence
P	Procurement*	RV	Review and Comment.
DC	Design Complete*	KR	Key Reviewer
CC	Certified for Construction*	IO	Information Only

Fig. 7. ASD document transmittal form.

SPALLATION NEUTRON SOURCE

PAGE 1 OF____.

DOCUMENT CHANGE NOTICE (DCN)

NOTE: USE THIS FORM TO INITIATE A NEW DOCUMENT AS A RESULT OF THIS PCR OR CHANGE AN EXISTING DOCUMENT	**DCN:** ASSIGNED BY CONFIGURATION MANAGEMENT

LIST AFFECTED DOCUMENTS: **(USE CONTINUATION PAGES, IF NEEDED)**

DOCUMENT TITLE	TYPE	NEW DRAWING(S)/ REVISION(S)	NEW DOCUMENT(S)/ REVISION(S)	COMPLETE DOCUMENT NUMBER (ASSIGNED BY DCC)	ASSIGNED BY DCC

TYPE CODES: SOW – Statement of Work (Drawings) A – Architectural L – Interface (s)
TS – Technical Specification E – Electrical M – Mechanical
P – Piping P – Parts Lists
I – Instrumentation SIZE: A - E

Designer	Engineer	Backup Materials Location

REASON(S) FOR CHANGE(S) (Provide as many details as possible)**:**

ASSOCIATED PCR NUMBER (When Applicable)	ASSOCIATED BCP NUMBER (When Applicable)	ORIGINATOR DATE

NOTE: All required signatures must be obtained prior to requesting Document Numbers.

COMPLETE ONLY FOR REVISED DOCUMENT(S)/DRAWING(S)	REVISED DOCUMENT(S) CLASS 0 – 4	REQUIRED FOR CLASS 0 – 3
SENIOR TEAM LEADER	DIVISION DIRECTOR APPROVAL	PROJECT DIRECTOR APPROVAL

Fig. 8. Document change notice.

3. INSTALLATION APPROACH

3.1 ALIGNMENT

The SNS Alignment System is a comprehensive grid of 16 external monuments, 650 floor monuments and 350 wall monuments (Fig. 9). The system design was based on extensive experience from recent accelerator projects in the U.S. Partner laboratory personnel have actively participated in the definition of the system. It is essential that the following high-level alignment activities be accomplished before the FE Building is made ready for equipment (RFE). It is also essential that the three monuments PP1, PP2, and PP3 be in place when the global network is established.

The high-level SNS alignment approach is as follows:

- Perform and adjust high-precision survey observations between the exterior monuments and the first three penetration points (in FE Building and linac).
- Perform and adjust high-precision survey observations of the floor and wall monuments in the FE Building and the linac up to PP3.
- Perform and adjust high-precision survey observations between the exterior monuments and the remaining six penetration points.
- Perform and adjust high-precision survey observations of the floor and wall monuments in the remainder of the tunnel (HEBT, ring, and RTBT).

3.2 FRONT-END SYSTEM

The front-end (FE) system initiates the negative hydrogen (H^-) beam and accelerates it to 2.5 MeV. The FE system is designed, developed, and procured by Lawrence Berkeley National Laboratory (LBNL), except for the associated radio-frequency (RF) system, which is being provided by Los Alamos National Laboratory (LANL). The Front End System will be completely assembled, tested and beam commissioned at LBNL. The Front End will then be disassembled and shipped to the SNS site. It will then be reassembled and retested in the Front End Building. ASD technical personnel responsible for the reassembly and retesting, and retesting in the FEB will be integral members of the activities at LBNL. The installation sequence for the following subsystems is covered in this section: Work Breakdown Structure (WBS) 1.03.01, Ion Source and low-energy beam transport (LEBT); WBS 1.03.02, RF Quadrupole (RFQ); and WBS 1.03.03, medium-energy beam transport (MEBT). The RF system for the FE is provided under WBS 1.04.01 and is covered in the Klystron Building section.

The high-level installation concept for the FE system beam-producing technical components is defined. Following the sequence for these primary structures are the primary installation steps for the remainder of the technical systems in the FE Building. In general, except for short-term physical interferences and space utilization, these two sequences will proceed in parallel after the overhead waveguide is installed.

All high level sequences are then broken down into the primary installation steps appropriate for those ASD subsystems. Additional activity details are provided in the ASD Detailed Installation Schedule. Ultimately, installation “travelers” will be developed for each technical component. See Fig. 10 for the linac tunnel-klystron building configuration and Figs. 11 through 13 for the general arrangement of the front-end building.

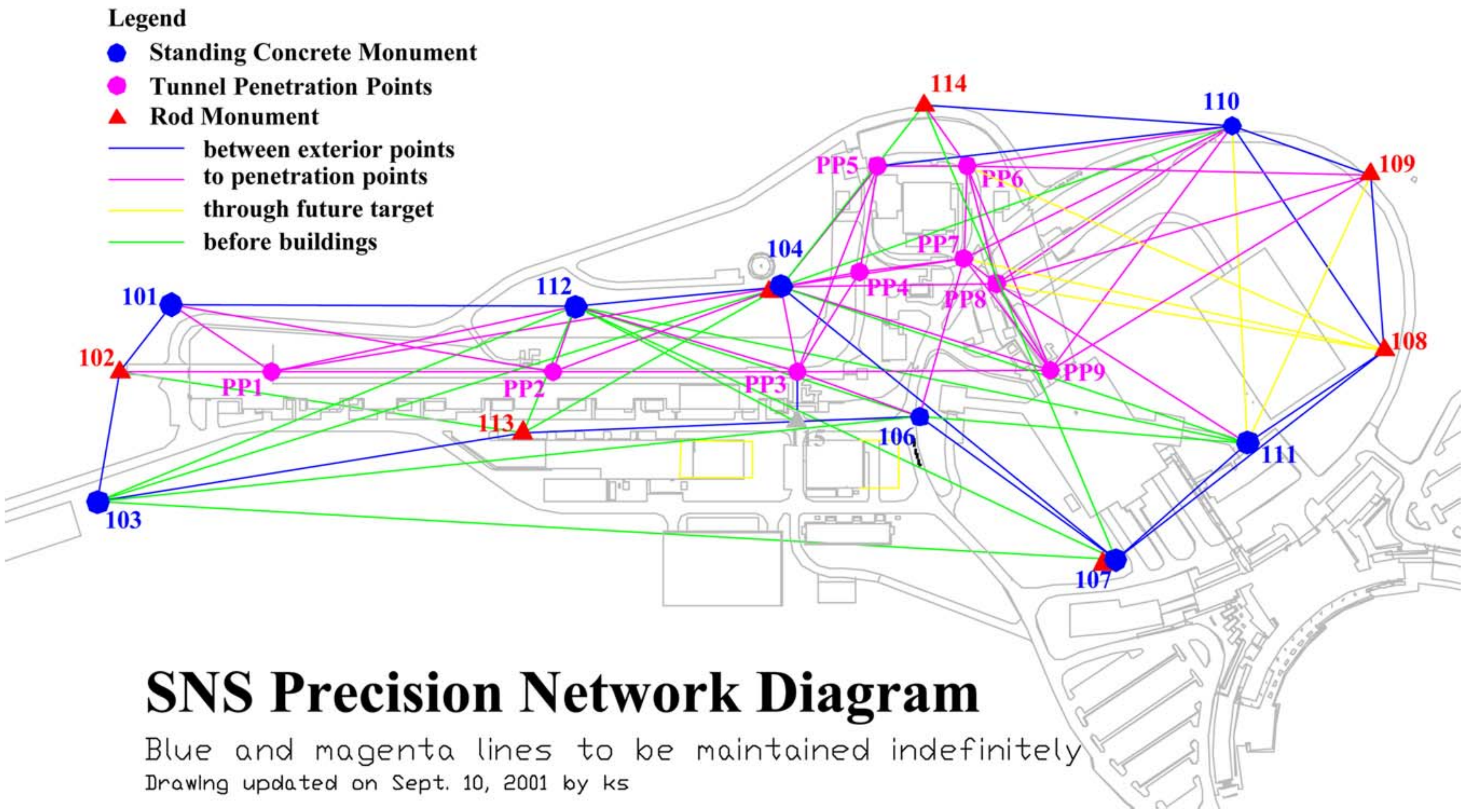


Fig. 9. SNS precision network diagram.

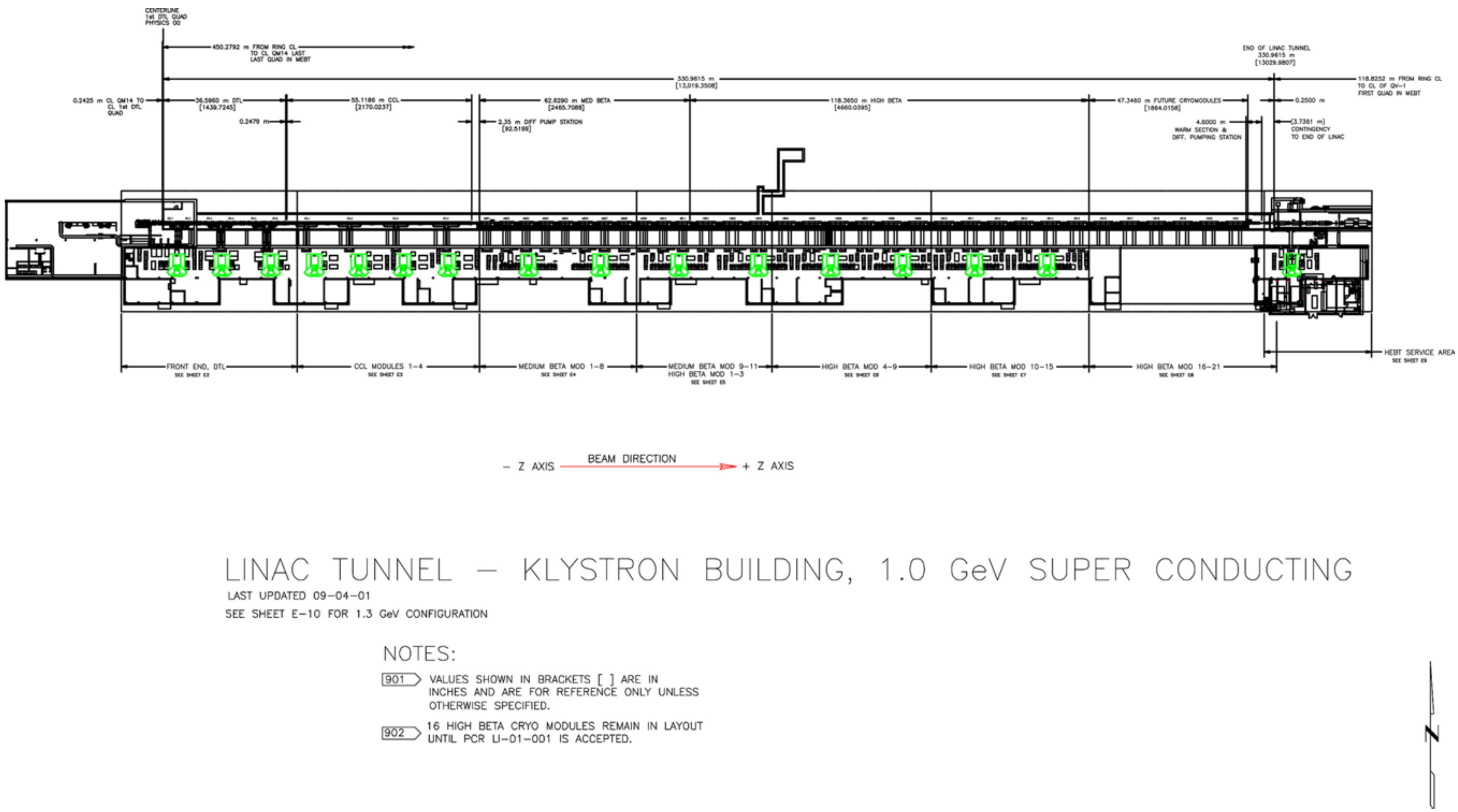


Fig. 10. Linac tunnel/klystron building configuration.

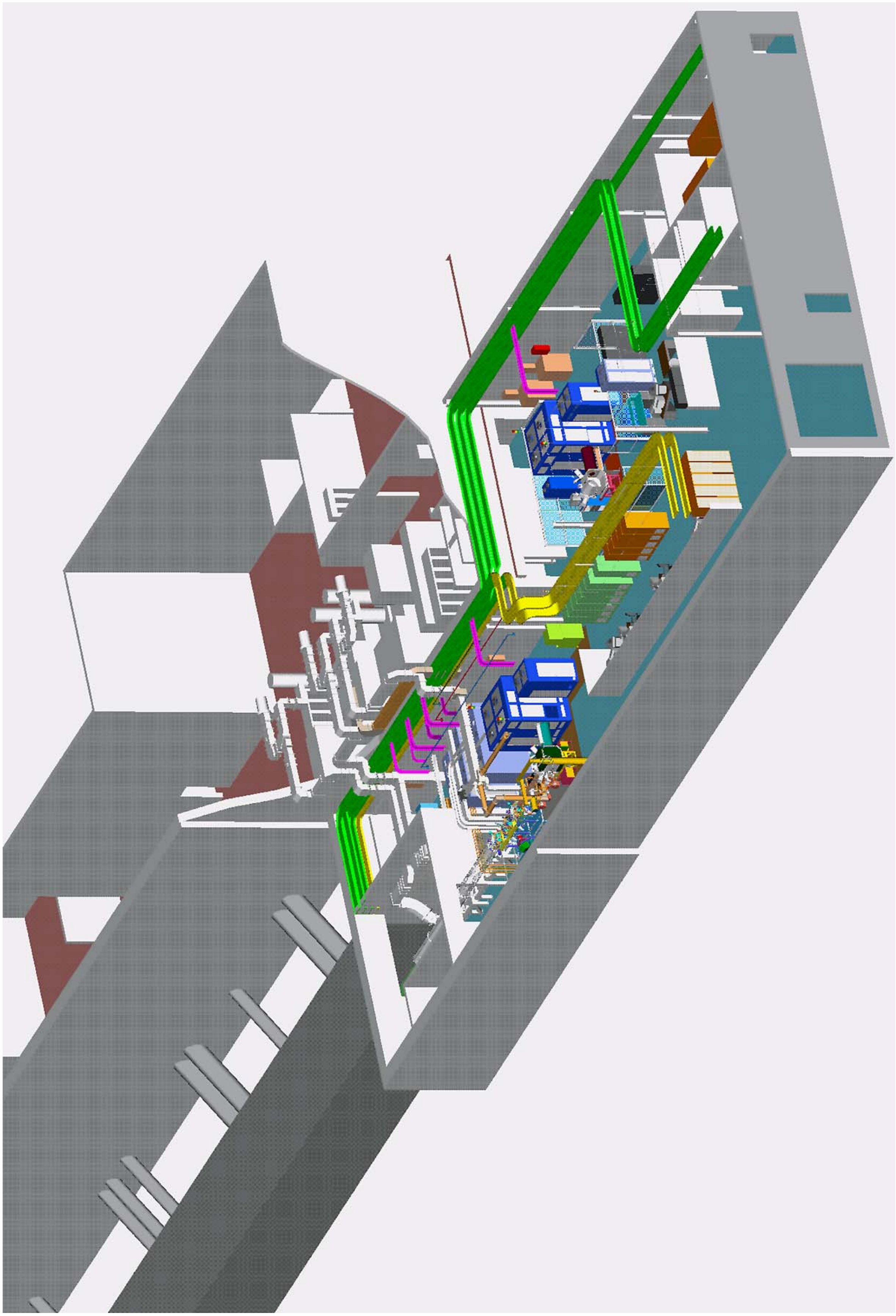


Fig. 11. Front-end building configuration.

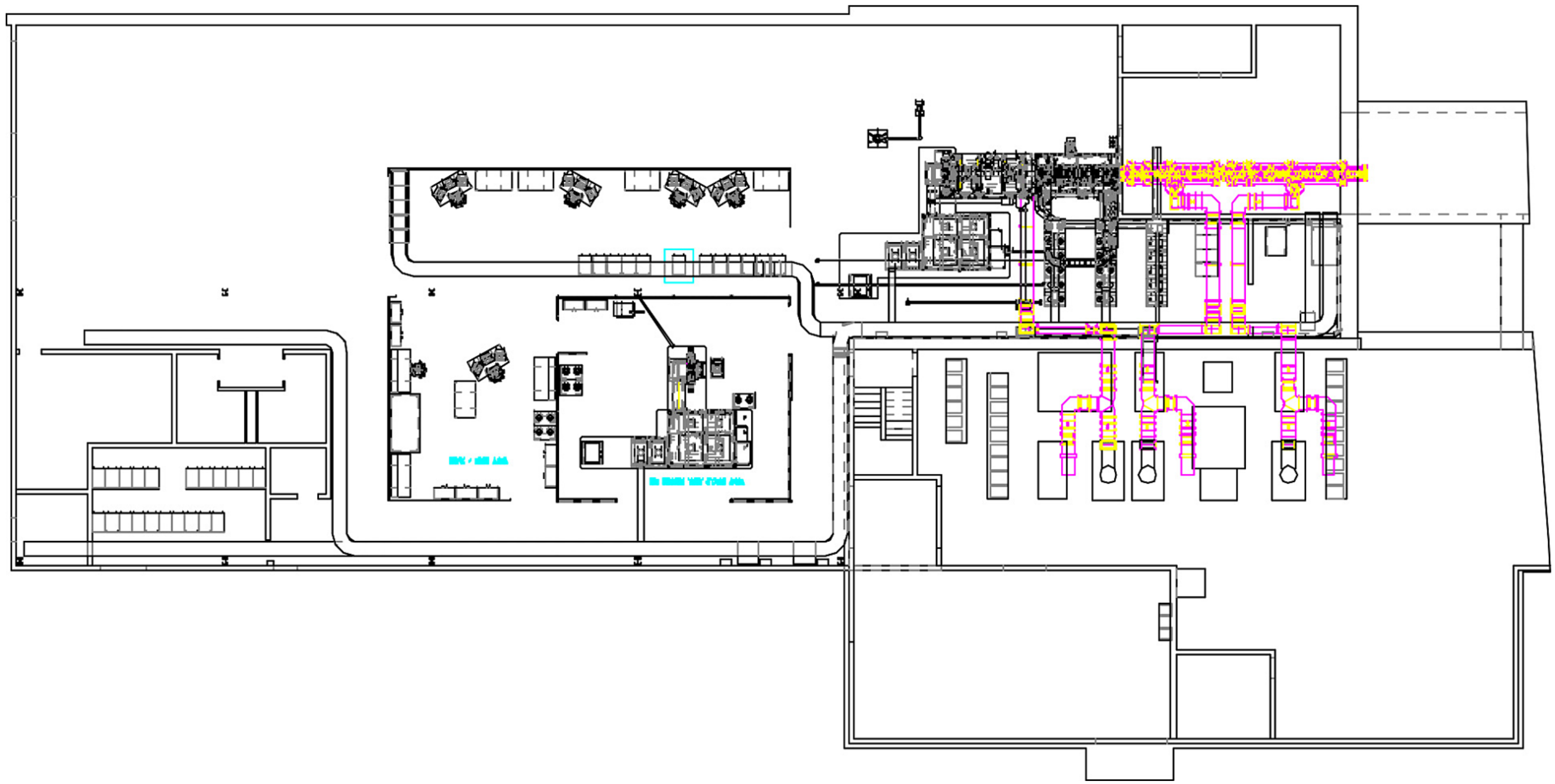
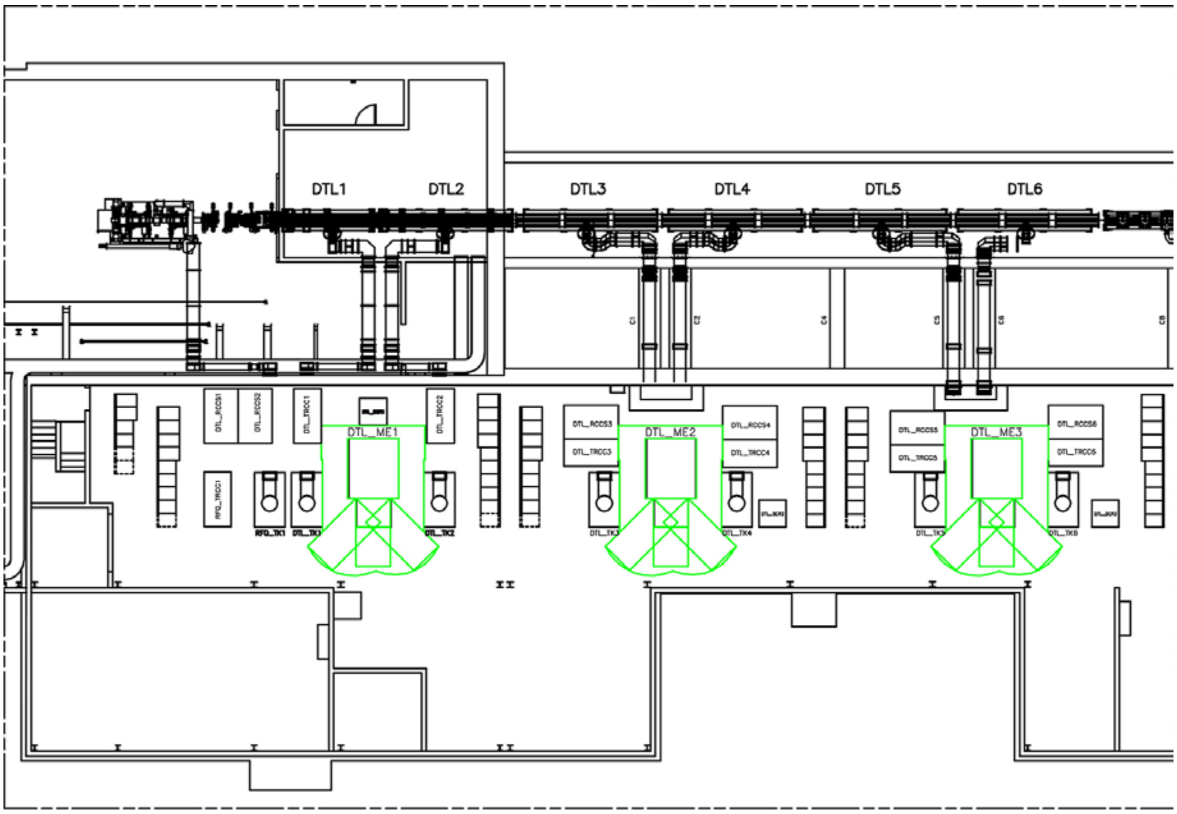


Fig. 12. Front-end building general arrangement.



901 902 FRONT END DTL–CCL
FROM SHEET E1, ZONE F7

NOTES:
901 ROW 1 CABINET NAMES ARE PRECEEDED BY RFQ_(SYSTEM DESIGNATION).
902 ROW 2 THRU ROW 7 CABINET NAMES ARE PRECEEDED BY DTL_(SYSTEM DESIGNATION).

RACK IDENTIFICATION TABLE (TOP DOWN)

RFQ	DTL 1 THRU DTL 6					
ROW 1	ROW 2	ROW 3	ROW 4	ROW 5	ROW 6	ROW 7
RFC:RFQCAB01	DIAG:DTL1CAB01	DIAG:DTL2CAB01	DIAG:DTL3CAB01	DIAG:DTL4CAB01	DIAG:DTL5CAB01	DIAG:DTL6CAB01
CTL:RFQCAB01	RFC:DTL1CAB01	RFC:DTL2CAB01	RFC:DTL3CAB01	RFC:DTL4CAB01	RFC:DTL5CAB01	RFC:DTL6CAB01
TR:RFQCAB01	CTL:DTL1CAB01	CTL:DTL2CAB01	CTL:DTL3CAB01	CTL:DTL4CAB01	CTL:DTL5CAB01	MAD:DTL1CAB01
TR:RFQCAB02	PS:DTL1CAB01	PS:DTL2CAB01	PS:DTL3CAB01	PS:DTL4CAB01	PS:DTL5CAB01	CTL:DTL6CAB01
SPARE	TR:DTL1CAB01	MEC:DTL2CAB01	TR:DTL3CAB01	MEC:DTL4CAB01	TR:DTL5CAB01	PS:DTL6CAB01
SPARE	TR:DTL1CAB02	TR:DTL2CAB01	TR:DTL3CAB02	TR:DTL4CAB01	TR:DTL5CAB02	MEC:DTL6CAB01
	RCCS:DTL1CAB01	TR:DTL2CAB02	RCCS:DTL3CAB01	TR:DTL4CAB02	RCCS:DTL5CAB01	TR:DTL6CAB01
	VAC:DTL1CAB01	RCCS:DTL2CAB01	VAC:DTL3CAB01	RCCS:DTL4CAB01	VAC:DTL5CAB01	TR:DTL6CAB02
	SPARE	VAC:DTL2CAB01	SPARE	VAC:DTL4CAB01	SPARE	RCCS:DTL6CAB01
		SPARE				VAC:DTL6CAB01

FRONT END, DTL

SHEET E2

Fig. 13. Front-end building and DTL general arrangement.

The FE component installation sequence is as follows:

- MEBT
- RFQ structures
- Source and LEBT vessel
- Diagnostics

The FE Building supporting systems installation sequence is as follows:

- Install bulk shielding (Pre-RFE)
- Verify integrity of global coordinate system in the FE Building
- Survey and mark technical component locations (Pre-RFE)
- Install cabling
- Install chillers
- Install overhead wave guide
- Align technical component to global survey network
- Install electrical/control racks
- Install high-voltage (HV) power supply
- Install RF system in Klystron Building
- Construct temporary control room
- Integrate with Global Controls System
- Install hot test stand
- Install personnel protection system
- Perform FE subsystem testing
- Install local shielding block to close bulk shield
- Install portion of machine protection system (MPS) as required
- *Start beam commissioning*

3.3 DRIFT TUBE LINAC SYSTEM

The drift tube linac (DTL) system is the copper accelerating structure and support that accelerates the beam from 2.5 to 87 MeV. This system includes six DTL tanks and all their auxiliary systems.

The DTL system is being designed, developed, and procured by LANL. The installation sequence for the following subsystems is covered under WBS 1.04.2, DTL Systems, and WBS 1.04.04, CCL Systems. WBS 1.04.01, RF Systems, is covered in the Klystron Building section. SNS will receive at least on DTL assembled for LANL. ASD will disassemble that unit(s) and reassemble it. All subsequent DTLs will be assembled from components by the SNS-ASD. DTL installation will be performed by ORNL-SNS with LANL support. See Figs. 13 and 14 for the DTL general arrangement.

The DTL installation sequence is determined by the commissioning plan for the FE/DTL1. The basis for that sequence is described in the ASD Commissioning Plan. The DTL tank installation sequence is as follows:

- DTL tank 3
- DTL tank 1 and linac D-Plate
- DTL tank 5

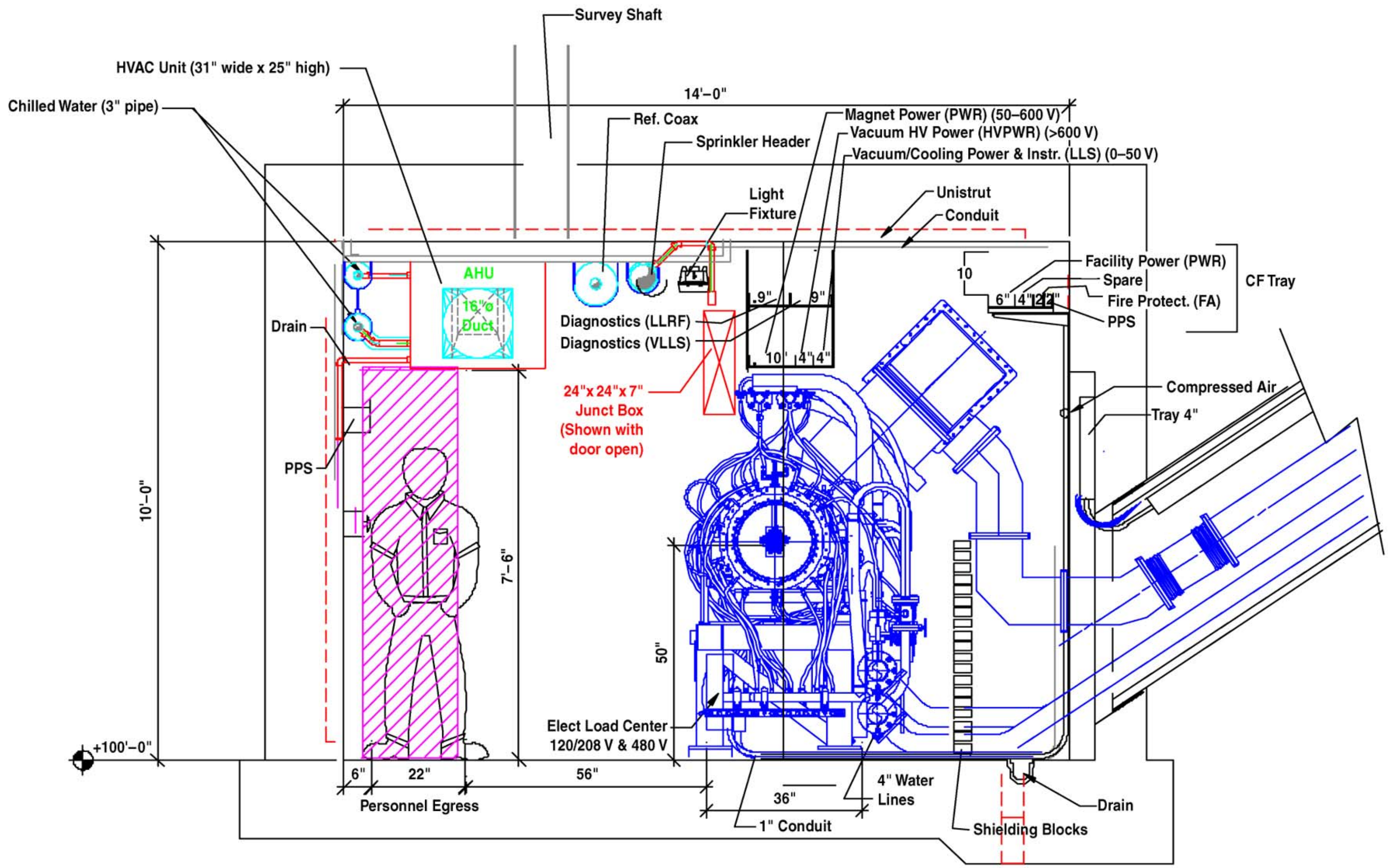


Fig. 14. DTL tunnel cross section.

- DTL tank 6
- DTL tank 4
- Remove D-Plate
- Verify alignment of DTL tank 1
- DTL tank 2

The DTL accelerating structure installation sequence is as follows:

- Verify integrity of global survey network
- Survey and mark technical component locations (Pre-RFE)
- Install cabling
- Roll tank assembly into linac tunnel
- Install main water system manifold
- Install vacuum spool sections and vacuum
- Install pumps, valves, and instrumentation
- Move support stand and DTL tank into beam line position
- Align DTL tank to upstream beam line components
- Connect main water system to Klystron Building
- Test water supply
- Connect vacuum system cabling
- Connect magnet power supplies
- Connect diagnostics
- Connect cooling system cabling
- Attach RF windows and wave guide
- Construct DTL/CCL shield wall (proposed)
- Certify personnel protection system for DTL testing
- Install machine protection system (MPS) as required
- Perform DTL subsystem testing and commissioning

The Klystron building installation sequence (DTL) is as follows:

- Verify integrity of global survey network
- Survey and mark technical components locations
- Install AC power distribution system (ASD)
- Install cable trays
- Install conduits
- Pull cables
- Install waveguides
- Prepare cooling water for technical components
- Prepare compressed air system for technical components
- Prepare and clean building for technical component installation
- Install DTL waveguide
- Install DTL cooling skid
- Install klystron cooling skid
- Install DTL Modulator
- Install DTL/RFQ klystron
- Integrate with Global Controls System
- Certify personnel protection system
- Verify RF tuning at low power
- Confirm X-ray shielding installation for Klystron
- Install machine protection system (MPS) as required
- Perform subsystem testing and conditioning

3.4 COUPLED CAVITY TUBE LINAC SYSTEM

The SNS coupled-cavity linac (CCL) system is the copper accelerating structure and supporting subsystems that increase the beam energy from 87 to 186 MeV. This system includes four full CCL modules and their auxiliary systems.

The CCL is being designed, developed, and procured by LANL. CCL installation will be performed by SNS-ASD with LANL support. SNS-ASD will receive tuned half modules and bridge couplers from the LANL supplier. SNS-ASD will then reassemble the complete CCL units. The reassembled units will be checked for frequency and alignment. After rechecking, the units will be dissembled and moved to the accelerator tunnel for installation.

The installation sequence for the following subsystems is covered under WBS 1.4.4, CCL Systems. WBS 1.4.1, RF Systems, is primarily the same as in the DTL Klystron Building section. See Figs. 15 and 16 for the general arrangement of CCL modules 1 through 4.

The component sequence of the CCL module installation is as follows:

- CCL module 1
- CCL module 2
- CCL module 3
- CCL module 4

The CCL accelerating structure installation sequence is as follows:

- Verify integrity of global survey network
- Survey and mark technical components locations
- Install cabling
- Install RF waveguide to last flex section
- Install first half module into linac tunnel
- Align first half module
- Make electrical connections
- Make utility connections
- Verify alignment
- Move second half module into tunnel
- Align second half module
- Make electrical connections
- Make utility connections
- Verify alignment
- Install bridge coupler between half modules
- Perform final leak check
- Connect RF waveguide to window flanges
- Connect special cables (diagnostics and HV)
- Verify alignment (Post bridge coupler verification)
- Vacuum system operated
- Certify personnel protection system
- Verify RF tuning at low power
- Install machine protection system (MPS) as required
- Perform subsystem testing and conditioning

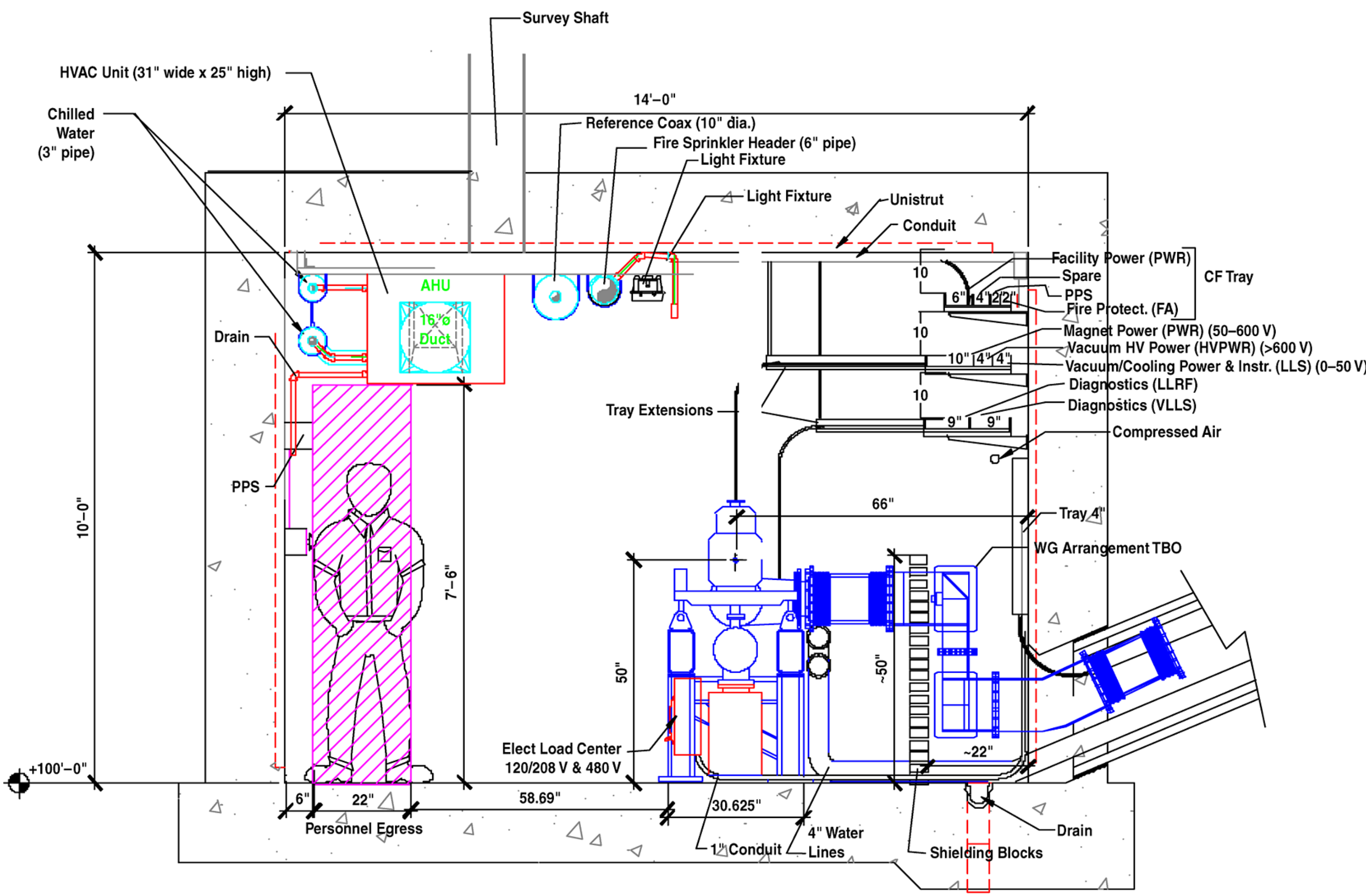
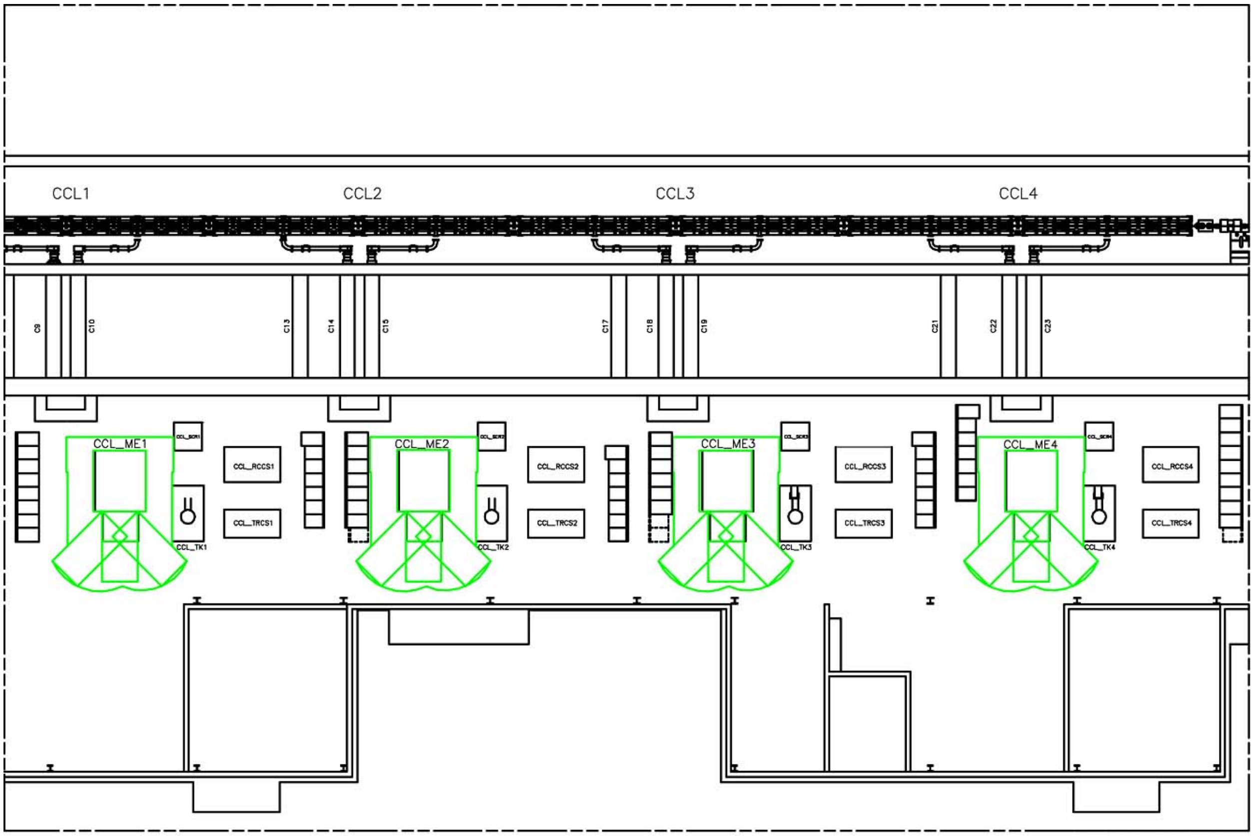


Fig. 15. CCL tunnel cross section.



901 CCL MODULES 1–4
FROM SHEET E1, ZONE F6–F7

NOTES:
901 ALL CABINET NAMES ARE PRECEEDED BY CCL_(SYSTEM DESIGNATION).

* = 480V POWER SUPPLY

RACK IDENTIFICATION TABLE (TOP DOWN)							
CCL1		CCL2		CCL3		CCL4	
ROW 1	ROW 2	ROW 3	ROW 4	ROW 5	ROW 6	ROW 7	ROW 8
DIAG:CCL1CAB01	RFC:CCL1CAB01	DIAG:CCL2CAB01	RFC:CCL2CAB01	DIAG:CCL3CAB01	RFC:CCL3CAB01	RFC:CCL4CAB01	DIAG:CCL4CAB01
DIAG:CCL1CAB02	MEC:CCL1CAB01	DIAG:CCL2CAB02	RCCS:CCL2CAB01	DIAG:CCL3CAB02	RCCS:CCL3CAB01	RCCS:CCL4CAB01	DIAG:CCL4CAB02
CTL:CCL1CAB01	TR:CCL1CAB01	CTL:CCL2CAB01	MEC:CCL2CAB01	CTL:CCL3CAB01	MEC:CCL3CAB01	MEC:CCL4CAB01	CTL:CCL4CAB01
CTL:CCL1CAB02	TR:CCL1CAB02	CTL:CCL2CAB02	TR:CCL2CAB01	CTL:CCL3CAB02	TR:CCL3CAB01	TR:CCL4CAB01	CTL:CCL4CAB02
PS:CCL1CAB01*	RCCS:CCL1CAB01	PS:CCL2CAB01	TR:CCL2CAB02	PS:CCL3CAB01	TR:CCL3CAB02	TR:CCL4CAB02	PS:CCL4CAB01
PS:CCL1CAB02	VAC:CCL1CAB01	PS:CCL2CAB02	VAC:CCL2CAB01	PS:CCL3CAB02	VAC:CCL3CAB01	VAC:CCL4CAB01	PS:CCL4CAB02
PS:CCL1CAB03	VAC:CCL1CAB02	PS:CCL2CAB03	VAC:CCL2CAB02	SPARE	VAC:CCL3CAB02	VAC:CCL4CAB02	PS:CCL4CAB03
PS:CCL1CAB04		SPARE		SPARE			PS:CCL4CAB04
							PS:CCL4CAB05
							SPARE

CCL MODULES 1–4

SHEET E3

Fig. 16. CCL modules 1 through 4 general arrangement.

3.5 SUPERCONDUCTING LINAC SYSTEM

The SNS superconducting (SC) linac is composed of the niobium cavities, cryostats, beam pipe warm section, differential-pumping stations, and the 2 K super fluid helium system that increase the beam energy from 186 to 1000 MeV. This system includes 11 medium-beta cryomodules with 33 cavities, 12 high-beta cryomodules with 48 cavities, an RF system powering each cavity, two differential pump stations, 22 inter cryomodule beam pipe warm sections, helium transfer lines, and the central helium liquefier. The SC Linac design was developed for 21 high beta cryomodules to allow for an energy upgrade in the future.

The SC structures and cryogenic components are being designed, developed, and procured by Thomas Jefferson National Accelerator Facility (JLab). The associated RF systems are being provided by LANL. SNS-ASD will receive completely assembled and tested from JLAB. U-tube jumpers to the cryogenics system and the warm beam pipes are received as separate subassemblies. Installation will be performed by ORNL-SNS with support from LANL and JLab. See Figs. 17 through 22 for the general arrangement of the medium- and high-beta cryomodules.

The installation sequence for the following subsections is covered in this section:

- WBS 1.04.10, Medium Beta Cryomodule
- WBS 1.04.11, High Beta Cryomodule
- WBS 1.04.14, Warm Beam Pipe
- WBS 1.04.12, CHL
- WBS 1.04.16, ORNL Cryogenic
- WBS 1.04.1.1.7, SCRF System
- WBS 1.04.1.3.2.2, SC Controls System

The component sequence of the SC linac installation is as follows:

- Install warm gas piping
- Install supply transfer line
- Install return transfer line
- Install Low-energy differential pump station
- Install Medium-beta cryomodules (1 through 3)
- Install Beam Pipe Warm Sections (1 through 3)
- Install Passive Dump for CCL test
- Install Dummy Cryomodule in CM position 21
- Medium-beta cryomodules (5 through 11)
- High-beta cryomodules (1 through 12)
- *Cryogenic Transfer Line Test*
- Beam pipe warm sections
- Dummy beam pipes
- High-energy differential pump station
- Install Medium-beta Cryomodule 4

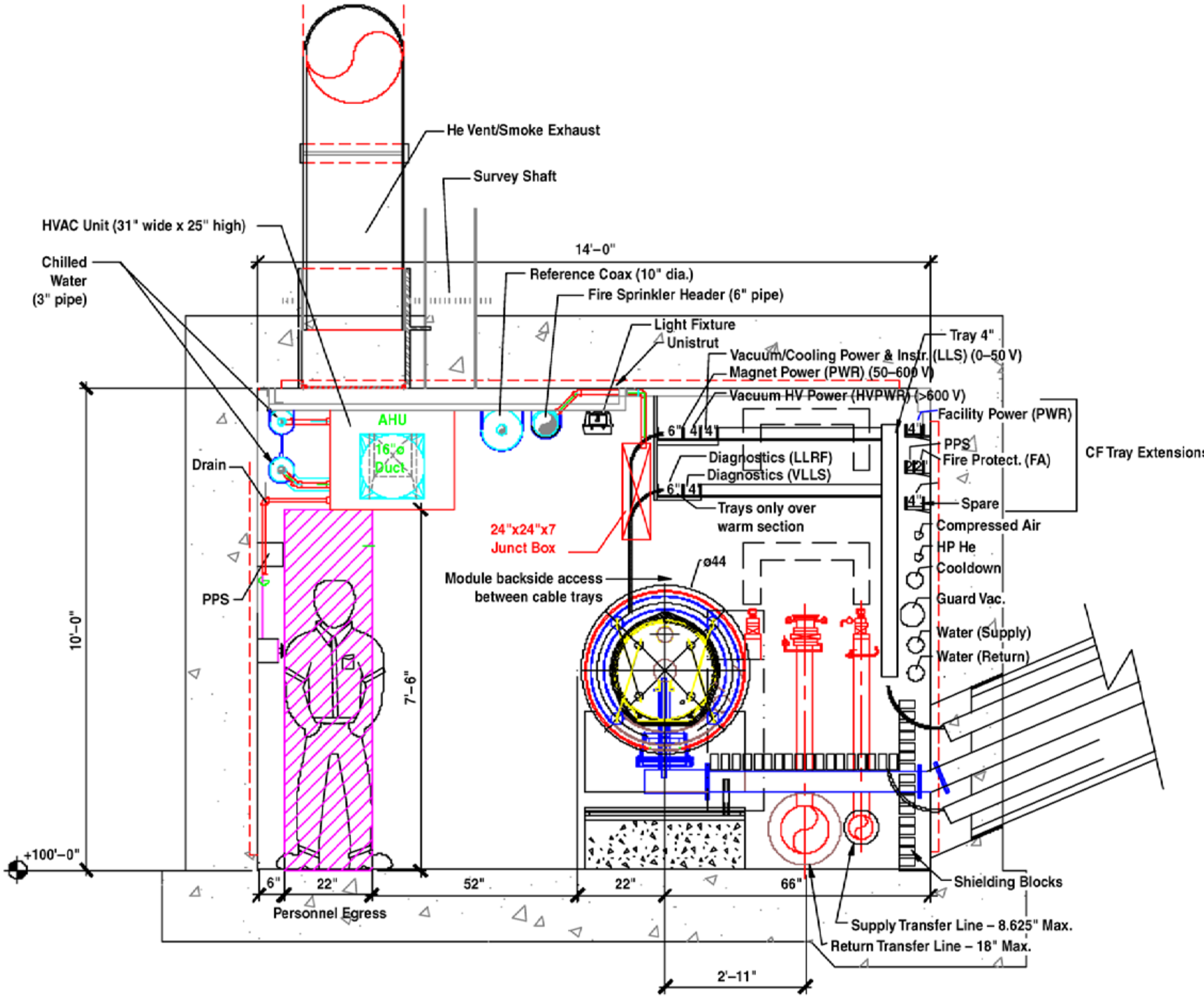
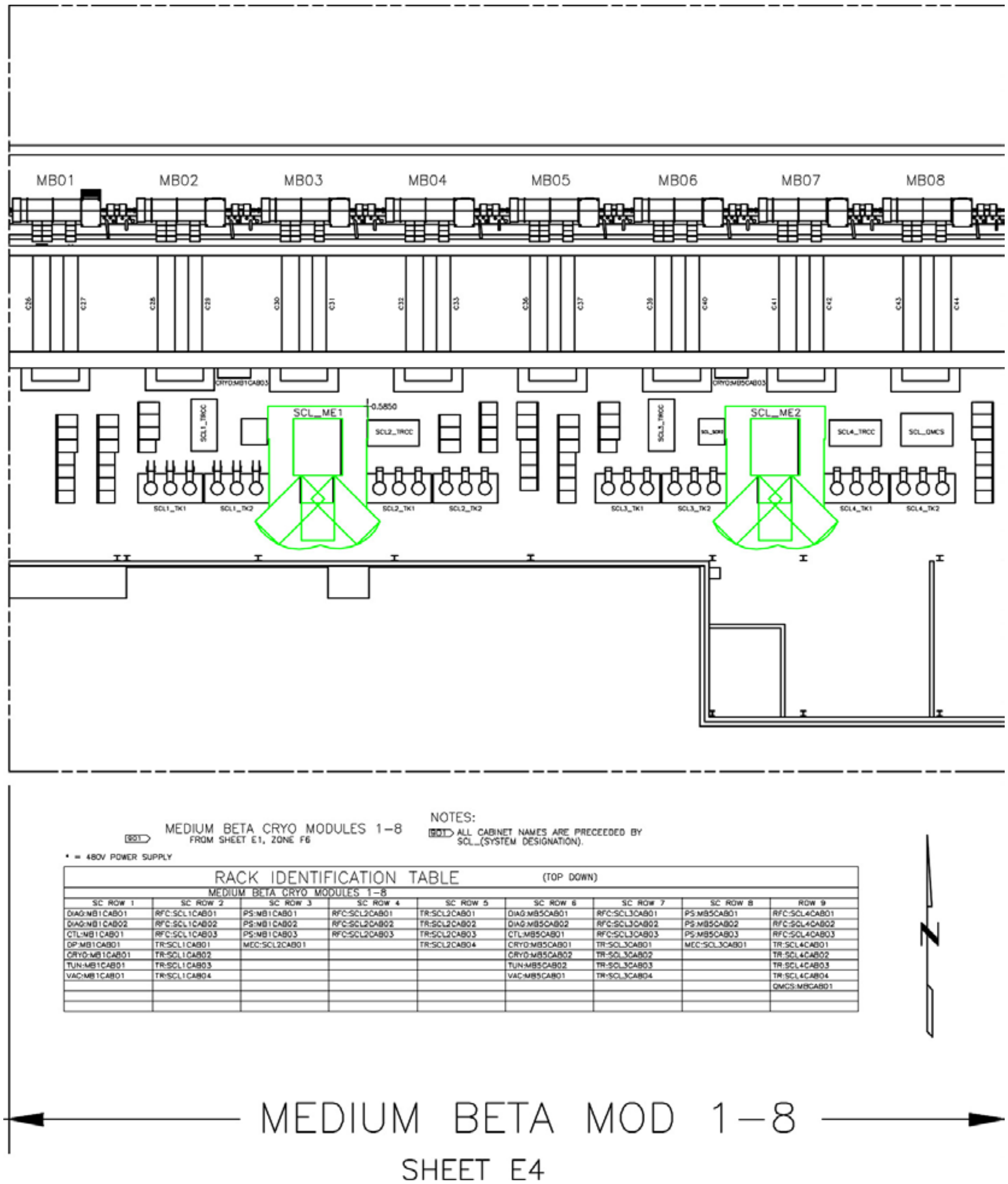


Fig. 17. Cryomodule tunnel cross section.



SC ROW 1	SC ROW 2	SC ROW 3	SC ROW 4	SC ROW 5	SC ROW 6	SC ROW 7	SC ROW 8	ROW 9
DIAG:MB1CAB01	RFC:SCL1CAB01	PS:MB1CAB01	RFC:SCL2CAB01	TR:SCL2CAB01	DIAG:MB5CAB01	RFC:SCL3CAB01	PS:MB5CAB01	RFC:SCL4CAB01
DIAG:MB1CAB02	RFC:SCL1CAB02	PS:MB1CAB02	RFC:SCL2CAB02	TR:SCL2CAB02	DIAG:MB5CAB02	RFC:SCL3CAB02	PS:MB5CAB02	RFC:SCL4CAB02
CTL:MB1CAB01	RFC:SCL1CAB03	PS:MB1CAB03	RFC:SCL2CAB03	TR:SCL2CAB03	CTL:MB5CAB01	RFC:SCL3CAB03	PS:MB5CAB03	RFC:SCL4CAB03
DP:MB1CAB01	TR:SCL1CAB01	MEC:SCL2CAB01		TR:SCL2CAB04	CRYO:MB5CAB01	TR:SCL3CAB01	MEC:SCL3CAB01	TR:SCL4CAB01
CRYO:MB1CAB01	TR:SCL1CAB02				CRYO:MB5CAB02	TR:SCL3CAB02		TR:SCL4CAB02
TUN:MB1CAB01	TR:SCL1CAB03				TUN:MB5CAB02	TR:SCL3CAB03		TR:SCL4CAB03
VAC:MB1CAB01	TR:SCL1CAB04				VAC:MB5CAB01	TR:SCL3CAB04		TR:SCL4CAB04
								QMCS:MBCAB01

Fig. 18. Medium-beta modules 1 through 8 general arrangement.

MEDIUM BETA CRYO MODULES 9–11
HIGH BETA CRYO MODULES 1–3
901 FROM SHEET E1, ZONE F5

NOTES:
901 ALL CABINET NAMES ARE PRECEEDED BY SCL_(SYSTEM DESIGNATION).

* = 480V POWER SUPPLY

RACK IDENTIFICATION TABLE (TOP DOWN)

MEDIUM BETA CRYO MODULES 9–11			HIGH BETA CRYO MODULES 1–3						
SC ROW 10	SC ROW 11	SC ROW 12	SC ROW 13	SC ROW 14	SC ROW 15	SC ROW 16	SC ROW 17	SC ROW 18	SC ROW 19
DIAG:MB9CAB01	RFC:SCL5CAB01	PS:MB9CAB01	RFC:SCL6CAB01	TR:SCL6CAB01	DIAG:HB1CAB01	RFC:SCL7CAB01	PS:HB1CAB01	RFC:SCL8CAB01	TR:SCL8CAB01
DIAG:MB9CAB02	RFC:SCL5CAB02	PS:MB9CAB02	RFC:SCL6CAB02	TR:SCL6CAB02	DIAG:HB1CAB02	RFC:SCL7CAB02	PS:HB1CAB02	RFC:SCL8CAB02	TR:SCL8CAB02
CTL:MB9CAB01	RFC:SCL5CAB03	PS:MB9CAB03	RFC:SCL6CAB03	TR:SCL6CAB03	CTL:HB1CAB01	RFC:SCL7CAB03	PS:HB1CAB03	RFC:SCL8CAB03	TR:SCL8CAB03
CRYO:MB9CAB01	TR:SCL5CAB01	MEC:SCL6CAB01		TR:SCL6CAB04	CRYO:HB1CAB01	TR:SCL7CAB01	MEC:SCL8CAB01		TR:SCL8CAB04
CRYO:MB9CAB02	TR:SCL5CAB02				CRYO:HB1CAB02	TR:SCL7CAB02			
TUN:MB9CAB03	TR:SCL5CAB03				TUN:HB1CAB04	TR:SCL7CAB03			
VAC:MB9CAB01	TR:SCL5CAB04				VAC:HB1CAB01	TR:SCL7CAB04			

MEDIUM BETA MOD 9–11
HIGH BETA MOD 1–3

SHEET E5

Fig. 19. Medium-beta modules 9 through 11 and high-beta modules 1 through 3 general arrangement.

901 HIGH BETA CRYO MODULES 4–9
FROM SHEET E1, ZONE F4

NOTES:
901 ALL CABINET NAMES ARE PRECEEDED BY SCL_(SYSTEM DESIGNATION).

* = 480V POWER SUPPLY

RACK IDENTIFICATION TABLE (TOP DOWN)

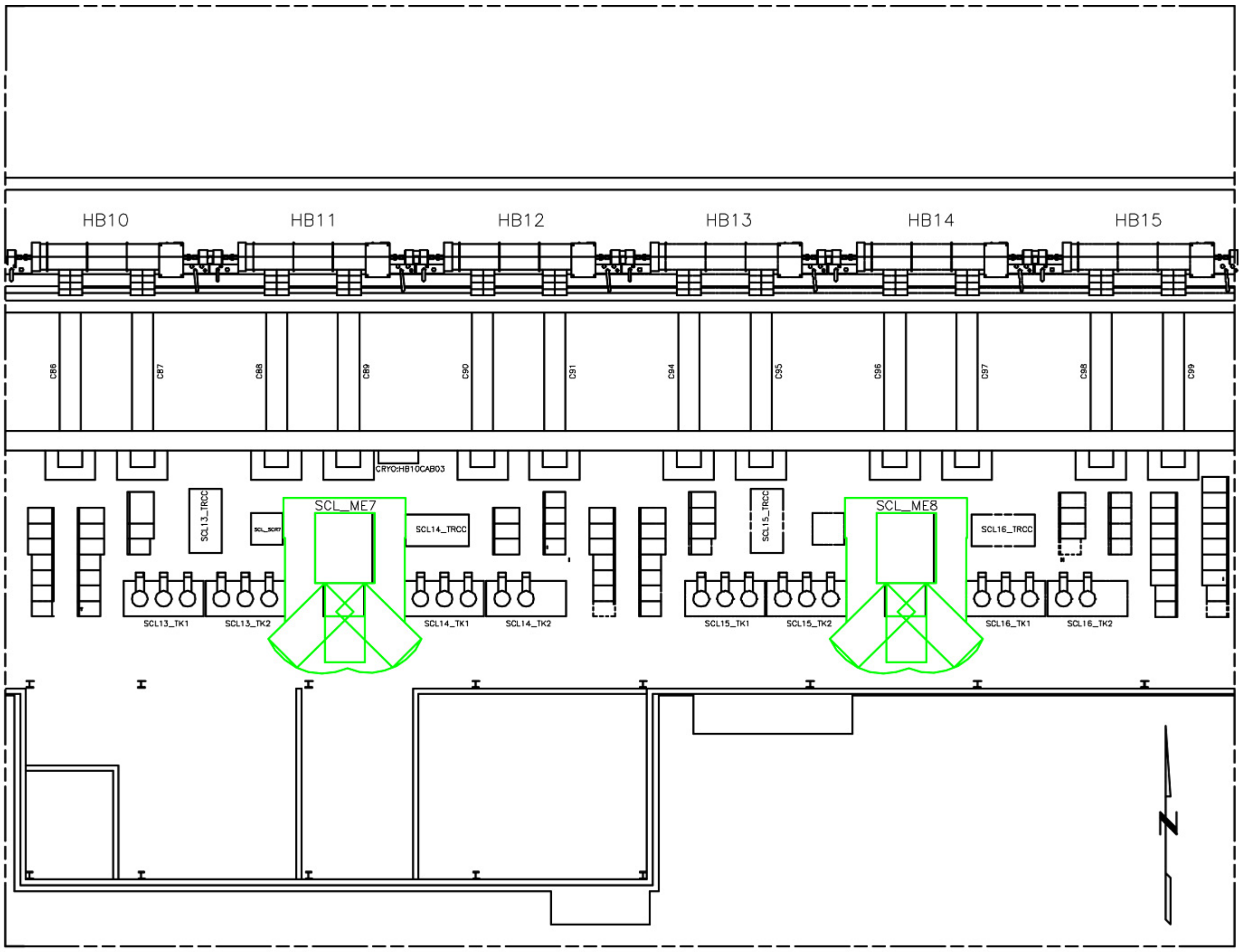
HIGH BETA CRYO MODULES 4–9

SC ROW 20	SC ROW 21	SC ROW 22	SC ROW 23	SC ROW 24	SC ROW 25	SC ROW 26	SC ROW 27	SC ROW 28	SC ROW 29
DIAG:HB4CAB01	RFC:SCL9CAB01	PS:HB4CAB01*	RFC:SCL10CAB01	TR:SCL10CAB01	DIAG:HB7CAB01	RFC:SCL11CAB01	PS:HB7CAB01*	RFC:SCL12CAB01	TR:SCL12CAB01
DIAG:HB4CAB02	RFC:SCL9CAB02	PS:HB4CAB02*	RFC:SCL10CAB02	TR:SCL10CAB02	DIAG:HB7CAB02	RFC:SCL11CAB02	PS:HB7CAB02	RFC:SCL12CAB02	TR:SCL12CAB02
CTL:HB4CAB01	RFC:SCL9CAB03	PS:HB4CAB03	RFC:SCL10CAB03	TR:SCL10CAB03	CTL:HB7CAB01	RFC:SCL11CAB03	MEC:SCL12CAB01	RFC:SCL12CAB03	TR:SCL12CAB03
CRYO:HB4CAB01	TR:SCL9CAB01	MEC:SCL10CAB01		TR:SCL10CAB04	CRYO:HB7CAB01	TR:SCL11CAB01	SPARE		TR:SCL12CAB04
CRYO:HB4CAB02	TR:SCL9CAB02				CRYO:HB7CAB02	TR:SCL11CAB02			
TUN:HB4CAB05	TR:SCL9CAB03				TUN:HB7CAB06	TR:SCL11CAB03			
VAC:HB4CAB01	TR:SCL9CAB04				VAC:HB7CAB01	TR:SCL11CAB04			

HIGH BETA MOD 4–9

SHEET E6

Fig. 20. High-beta modules 4 through 9 general arrangement.



901 902 HIGH BETA CRYO MODULES 10–15
FROM SHEET E1, ZONE F4

* = 480V POWER SUPPLY

NOTES:

901 ALL CABINET NAMES ARE PRECEEDED BY SCL_(SYSTEM DESIGNATION).

902 HIGH BETA CRYO MODULES 13–15 REMAIN IN LAYOUT UNTIL PCR LI–01–001 IS ACCEPTED.

RACK IDENTIFICATION TABLE (TOP DOWN)

HIGH BETA CRYO MODULES 10–15

SC ROW 30	SC ROW 31	SC ROW 32	SC ROW 33	SC ROW 34	SC ROW 35	SC ROW 36	SC ROW 37	SC ROW 38	SC ROW 39	SC ROW 40	SC ROW 41
DIAG:HB10CAB01	RFC:SCL13CAB01	PS:HB10CAB01*	RFC:SCL14CAB01	TR:SCL14CAB01	DIAG:HB13CAB01	RFC:SCL15CAB01	PS:HB13CAB01*	RFC:SCL16CAB01	TR:SCL16CAB01	DIAG:HB16CAB01	DIAG:HB21CAB01
DIAG:HB10CAB02	RFC:SCL13CAB02	PS:HB10CAB02*	RFC:SCL14CAB02	TR:SCL14CAB02	DIAG:HB13CAB02	RFC:SCL15CAB02	PS:HB13CAB02	RFC:SCL16CAB02	TR:SCL16CAB02	DIAG:HB16CAB02	DIAG:HB21CAB02
CTL:HB10CAB01	RFC:SCL13CAB03	PS:HB10CAB03	RFC:SCL14CAB03	TR:SCL14CAB03	CTL:HB13CAB01	RFC:SCL15CAB03	PS:HB13CAB03	RFC:SCL16CAB03	TR:SCL16CAB03	CTL:HB16CAB01	CTL:HB21CAB01
CRYO:HB10CAB01	TR:SCL13CAB01	MEC:SCL14CAB01		TR:SCL14CAB04	CRYO:HB13CAB01	TR:SCL15CAB01	MEC:SCL15CAB01	SPARE	TR:SCL16CAB04	PS:HB16CAB01*	PS:HB21CAB01*
CRYO:HB10CAB02	TR:SCL13CAB02				CRYO:HB13CAB02	TR:SCL15CAB02				PS:HB16CAB02*	PS:HB21CAB02*
TUN:HB10CAB07	TR:SCL13CAB03				TUN:HB13CAB06	TR:SCL15CAB03				PS:HB16CAB03	PS:HB21CAB03*
VAC:HB10CAB01	TR:SCL13CAB04				VAC:HB13CAB01	TR:SCL151CAB04				DP:HB16CAB01	PS:HB21CAB04
					SPARE					VAC:HB16CAB01	VAC:HB21CAB01
											SPARE

HIGH BETA MOD 10–15

SHEET E7

Fig. 21. High-beta modules 10 through 15 general arrangement.

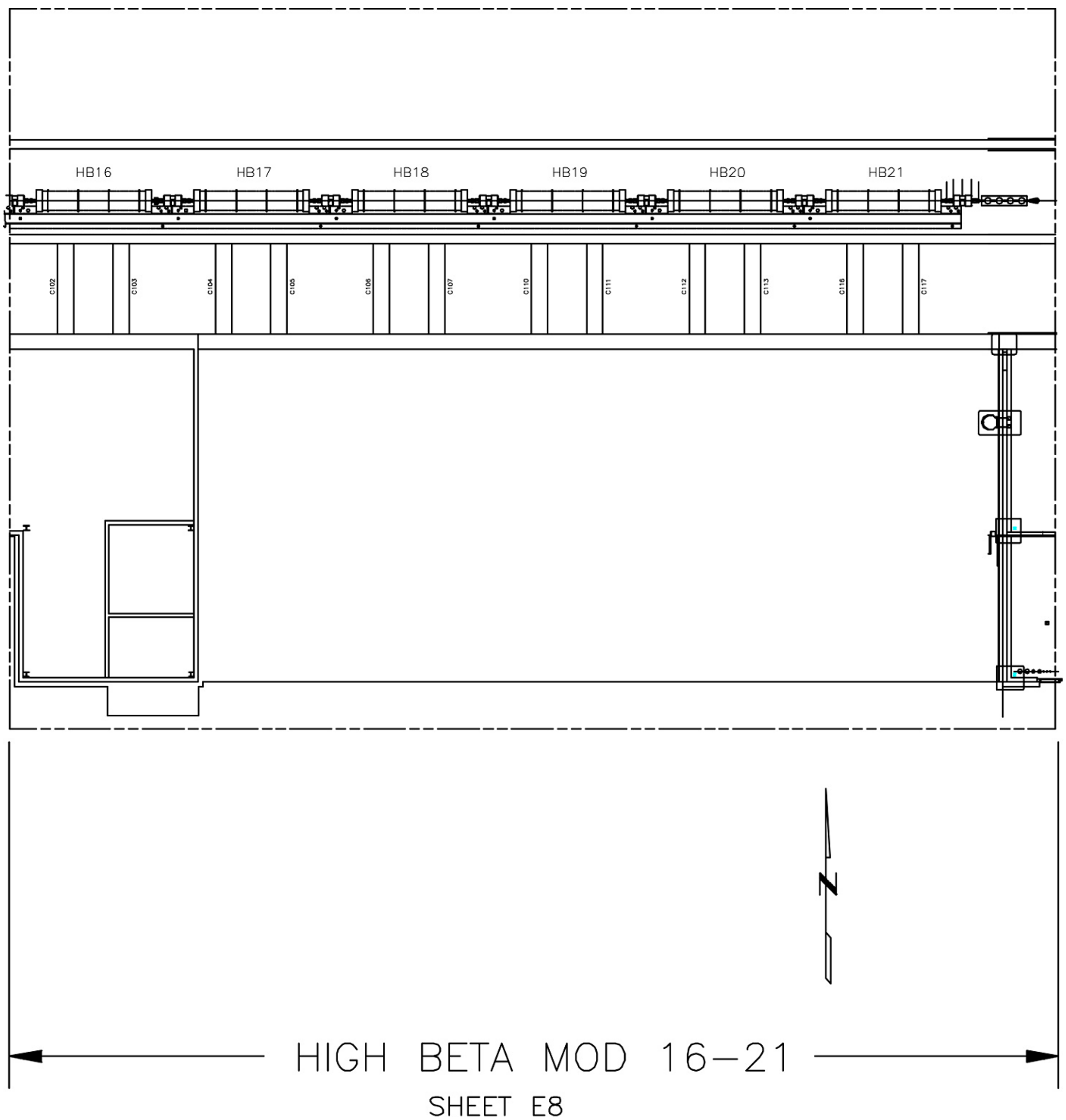


Fig. 22. High-beta modules 16 through 21 general arrangement.

The SC installation sequence is as follows:

- Verify integrity of global survey network
- Survey and mark technical components locations
- Install cabling
- Install RF waveguide to last flex section
- Install cryomodule
- Rough align cryomodule
- Install diagnostics and RF cabling
- Prepare coupler for hookup
- Attach waveguide to coupler
- Final align cryomodule
- Connect U-tubes to cryogenic system
- Low-power checkout
- Warm section check installation
- Warm section checkout
- Helium system full operation
- High-power checkout

The SC klystron building installation sequence is as follows:

- Verify integrity global survey network
- Survey and mark technical components locations
- Install AC power distribution system (ASD)
- Install cable trays
- Install conduits
- Pull cables
- Install waveguides
- Prepare cooling water/DI water for technical components
- Prepare compressed air system for technical components
- Prepare and clean building for technical component installation
- Install waveguide
- Install cooling skid
- Install klystron cooling skid
- Install modulator
- Install klystron
- Integrate with Global Controls System
- Certify personnel protection system
- Verify RF tuning at low power
- Perform subsystem testing and conditioning

The initial level of detail in the installation planning for the CCL and SC klystron building areas is the same as that defined for the DTL klystron building.

The central helium liquefier (CHL) installation is performed primarily (75%) through fixed-price subcontracts. The CHL is not covered in this plan.

3.6 HEBT/RING/RTBT SYSTEM

The high-energy beam transport (HEBT) line delivers the 1.0-GeV beam from the SC linac to the injection septum. The HEBT is 170 m long and starts at the SC high-energy differential pumping station and ends at the injection septum center. It contains 16.5 focus/defocus (FODO) cells, 2 betatron collimators, 4 foil collimators, and 2 RF cavities. One of the RF cavities is for energy correction, and the other is an energy spreader. Major components include 9 dipoles, 40 quadrupoles, 18 correctors, 47 power supplies, 112 diagnostics, and the vacuum subsystem.

The main Ring System is 248 m in circumference and accumulates 1060 turns over a period of 945 ns. The ring system includes 32 large dipoles, 4 chicane dipoles, 3 septa, 8 injection kickers, 2 extraction kickers (14 sub units), 52 quadrupoles, 116 correctors, 20 sextupoles, 3 collimators, 4 RF cavities and associated power supplies, vacuum, RF power, diagnostics, and dionized cooling water systems.

The ring-to-target beam transport (RTBT) line delivers the 1.0 GeV beam from the extraction kicker to the target. The RTBT is 151 m long. It contains 2 betatron collimators and 15 FODO cells (11.6 m). Technical components in the RTBT include 16.8 degree dipole, 32 quads, 15 dipole correctors, 4 spreading correctors, and 17 beam position monitors.

The HEBT/RING/RTBT SYSTEM is being designed, developed, and procured by Brookhaven National Laboratory (BNL). The 5-MW klystron subsystem that powers the two cavities in the HEBT is being provided by LANL. HEBT installation will be performed by SNS-ASD with BNL support. HEBT/RTBT magnets will be shipped directly from vendors to SNS-ASD for testing prior to installation. The 32 ring arc half cells will be delivered as completed/tested assembles. See Figs. 23 and 24 for the general arrangement of the HEBT.

The installation sequence for the following HEBT subsystems is covered in this section:

- WBS 1.05.01.01, HEBT Magnets and Support
- WBS 1.05.01.02, HEBT High Power–Power Supplies
- WBS 1.05.01.03, HEBT Vacuum System
- WBS 1.05.01.04, HEBT Instrumentation
- WBS 1.05.01.05, HEBT Scraper Collimator Shielding
- WBS 1.05.01.06, HEBT Debuncher Compressor RF Systems

See Figs. 25 and 26 for the full layout of the ring, Fig. 27 for the layout of the ring service building, Fig. 28 for the ring building mezzanine layout, and Fig. 29 for the RTBT general arrangement.

The component sequence of the HEBT installation assumes that the three ring subsystems (HEBT, linac HEBT, and the linac dump) start at the "far point" from the linac access ramp and progress back to the ramp. This approach prevents later components from passing work in progress or aligned components. The high-level sequence is as follows:

- Linac dump components—starts at linac dump/beam pipe/DC V6 ends at QH1
- Main HEBT components including RF debuncher cavity—Starts at QH34 ends at DH11/QV11
- Linac HEBT components—Starts at QV1 and ends at QH10
- Collimators (2)
- RF energy corrector cavity
- (The three subsystems may proceed in parallel)

The installation sequence for the following HEBT Service Building subsections is covered in this section:

- Install two 805-MHz, 5-MW klystrons
- Install RF local controls
- Install remainder of HEBT service building racks, power supplies, and controls
- Conduct subsystem tests of HEBT, RF, and magnet systems

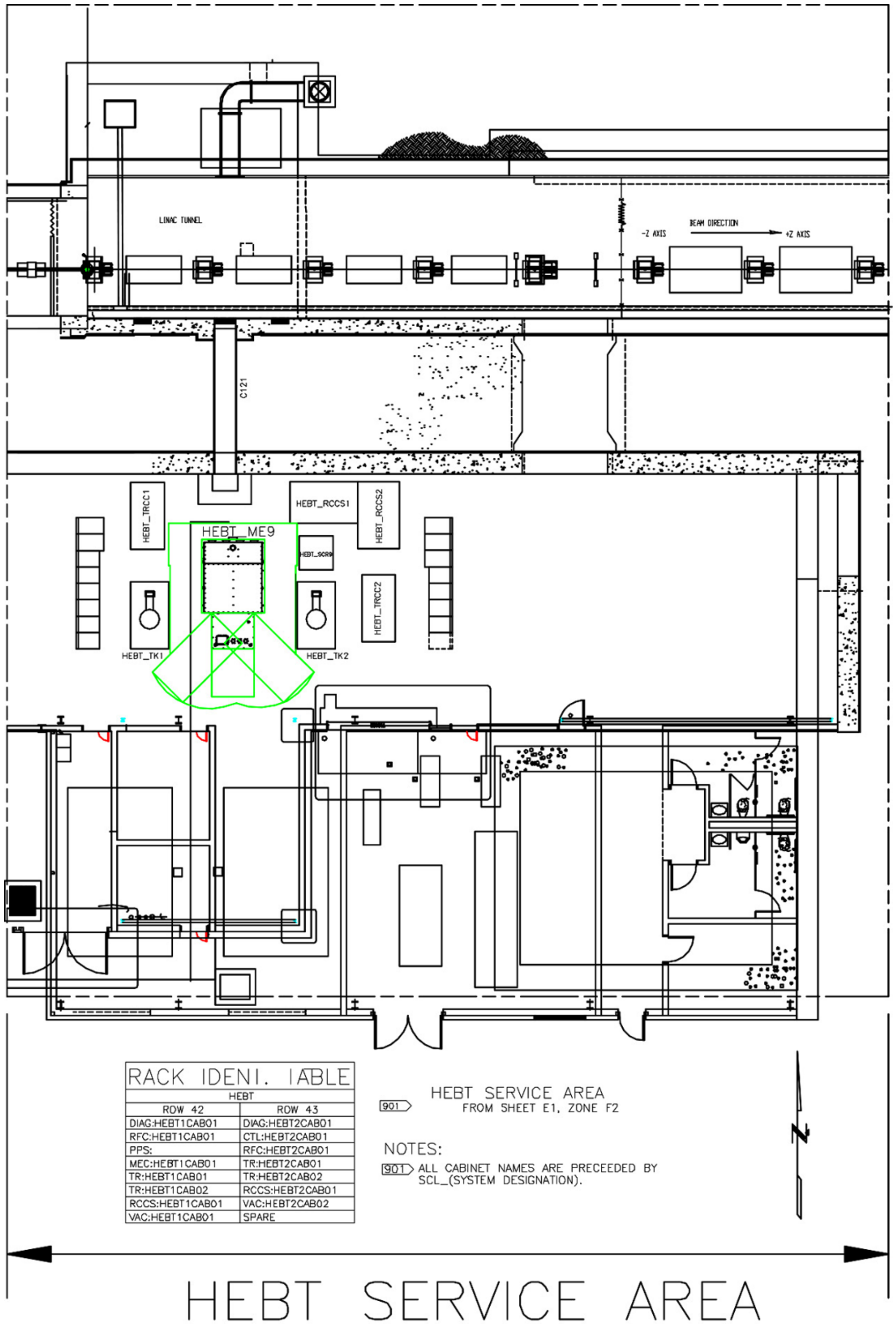


Fig. 23. HEBT Service Building general arrangement.

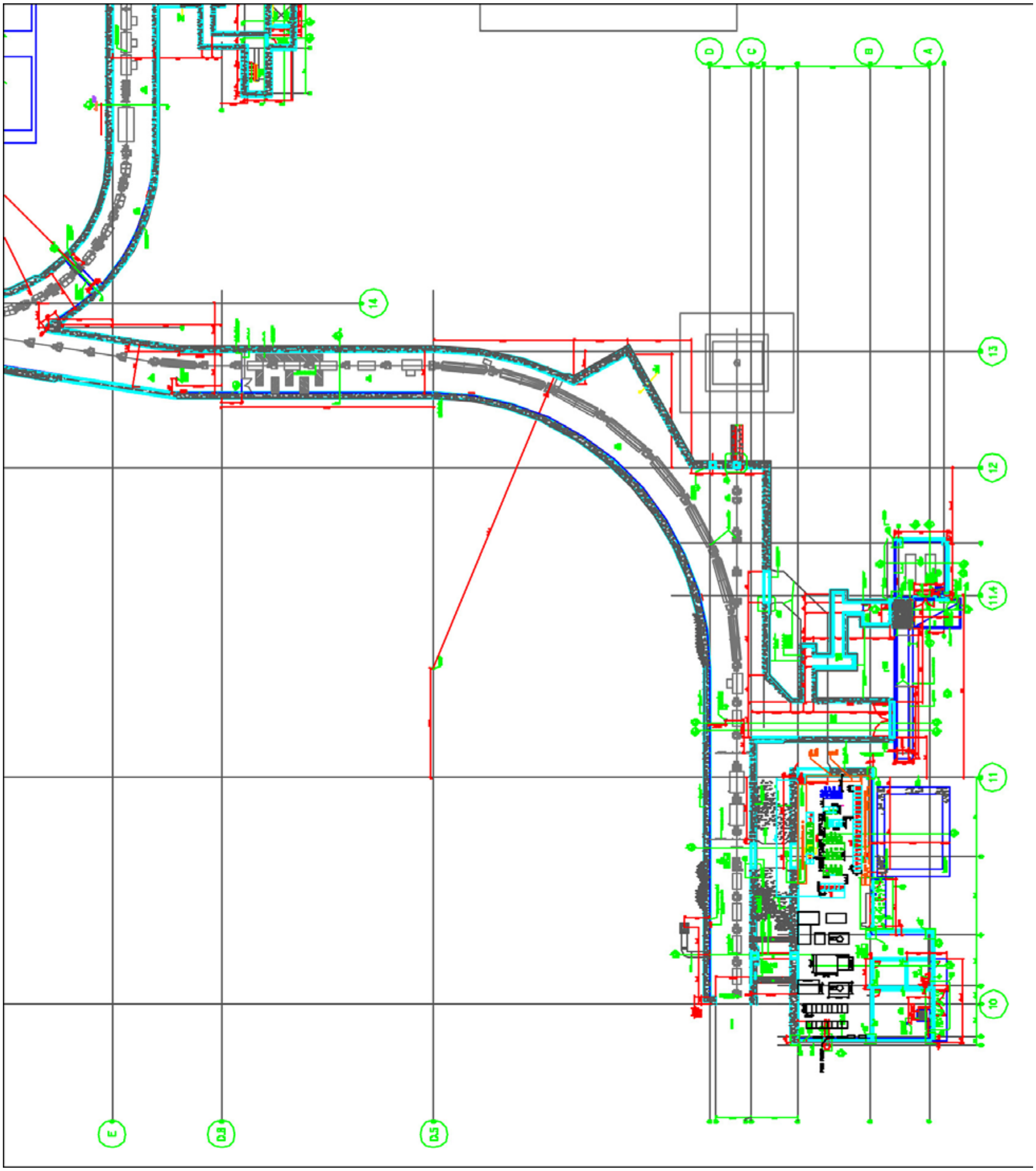


Fig. 24. HEBT general arrangement.

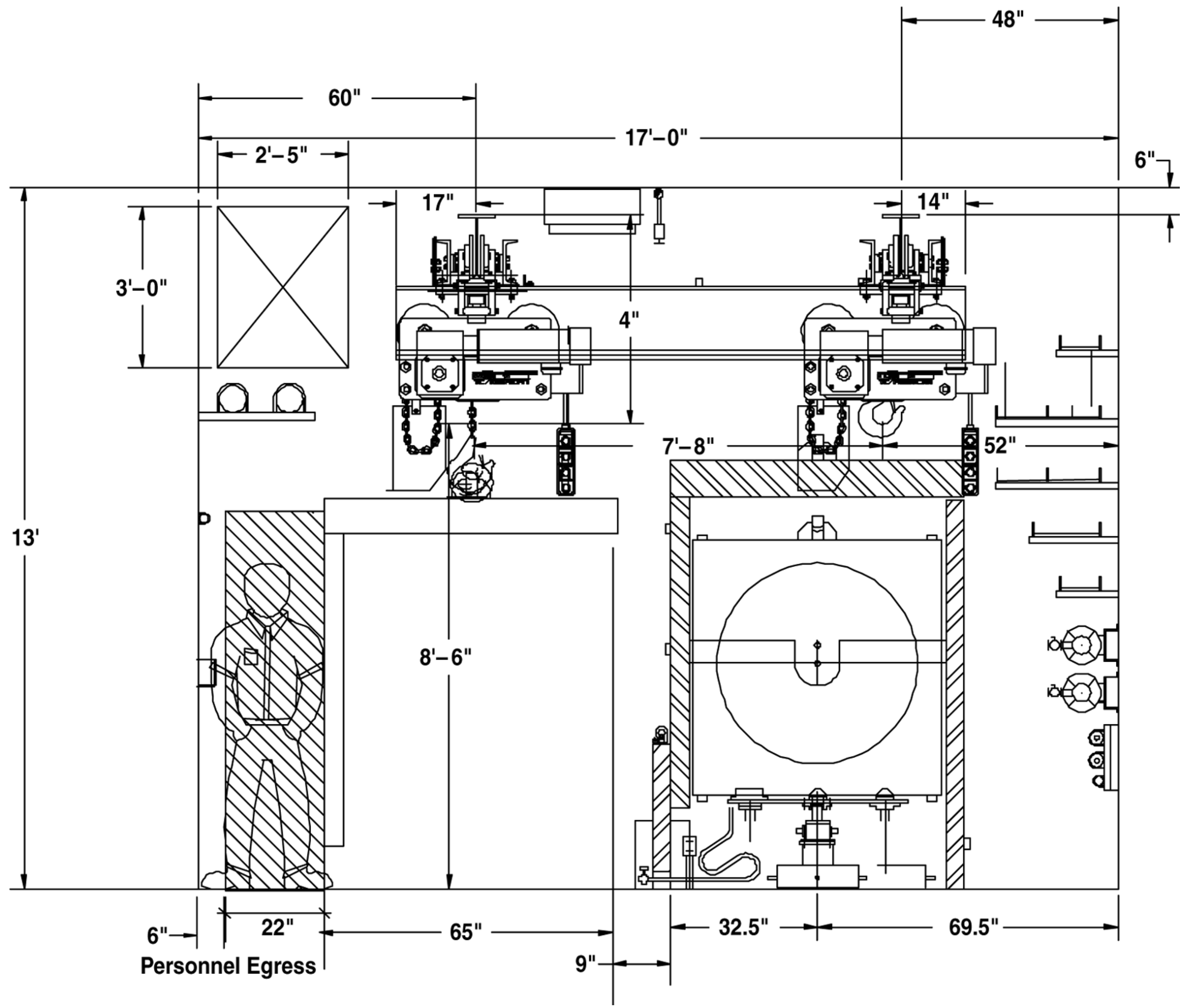


Fig. 25. Ring tunnel cross section.

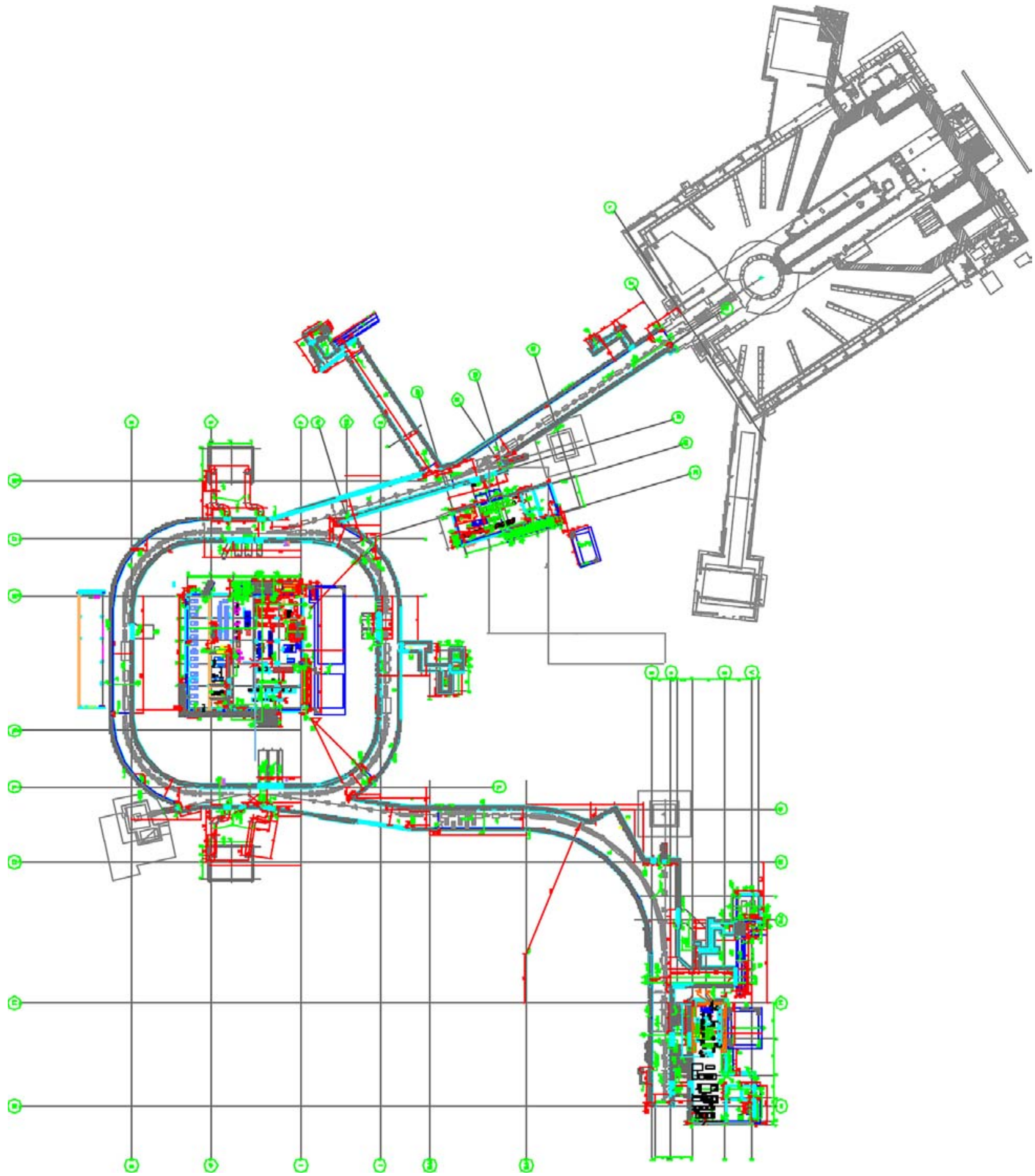


Fig. 26. Ring System configuration.

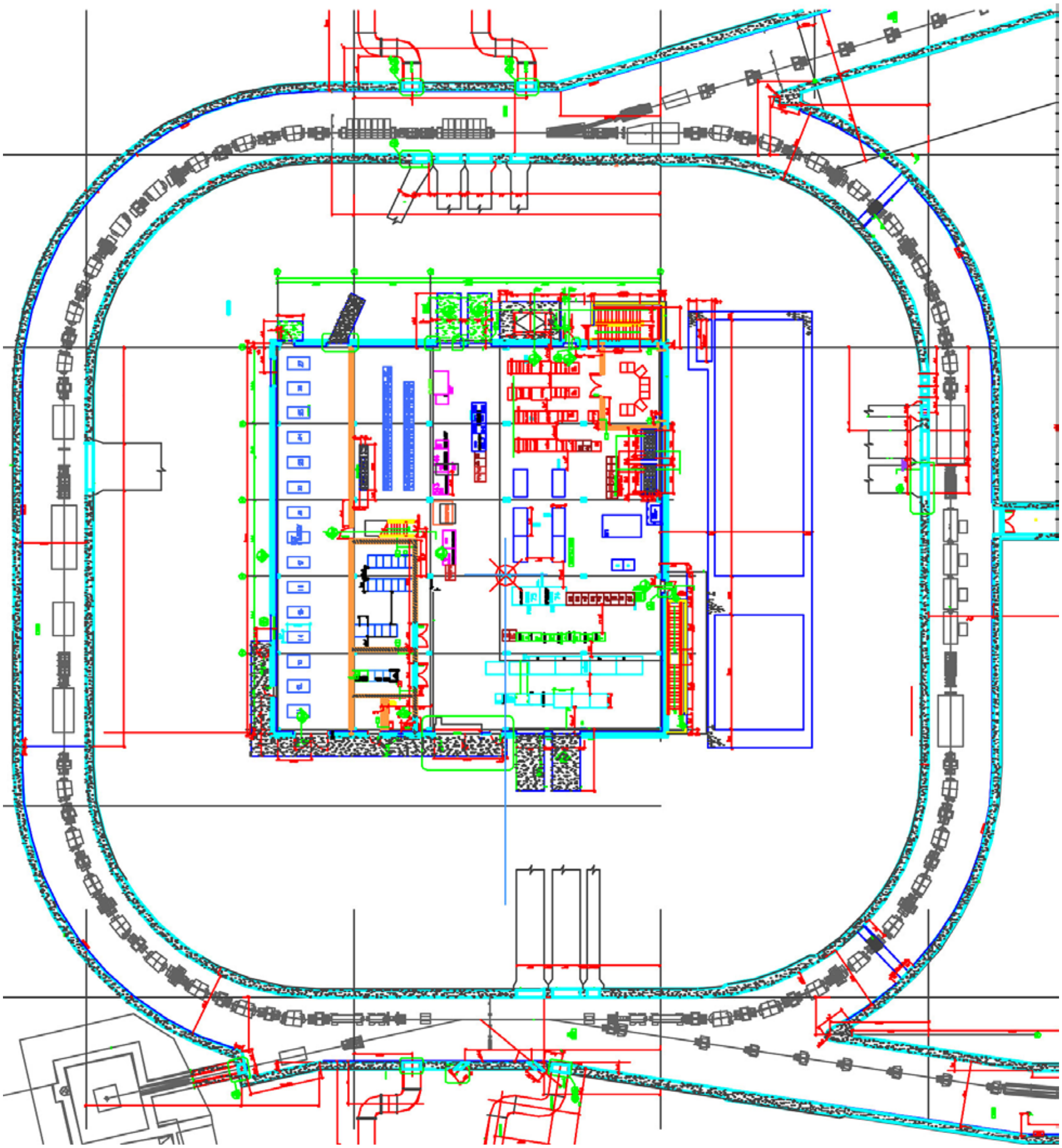


Fig. 27. Ring Service Building general arrangement.

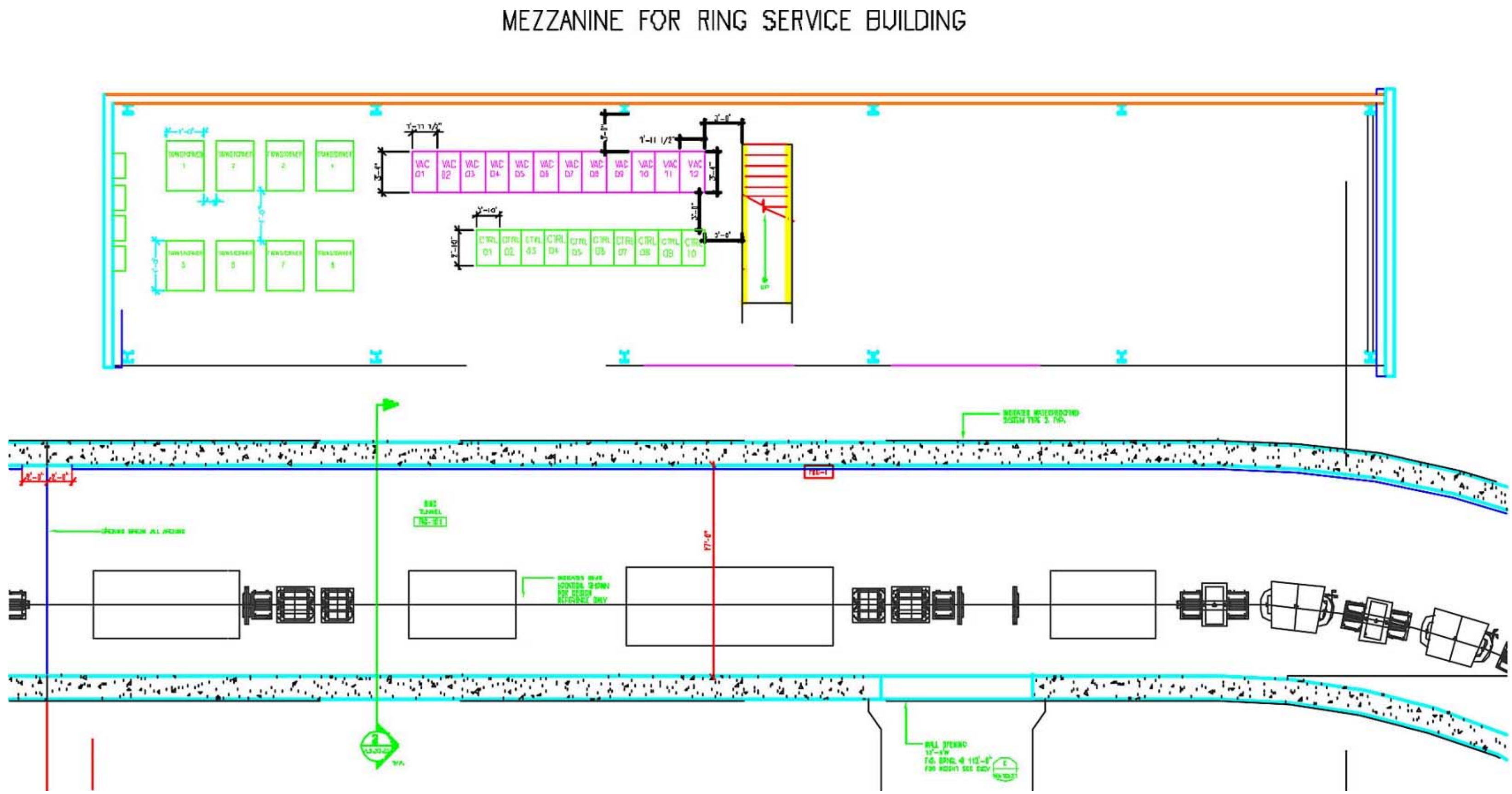


Fig. 28. Ring building mezzanine general arrangement.

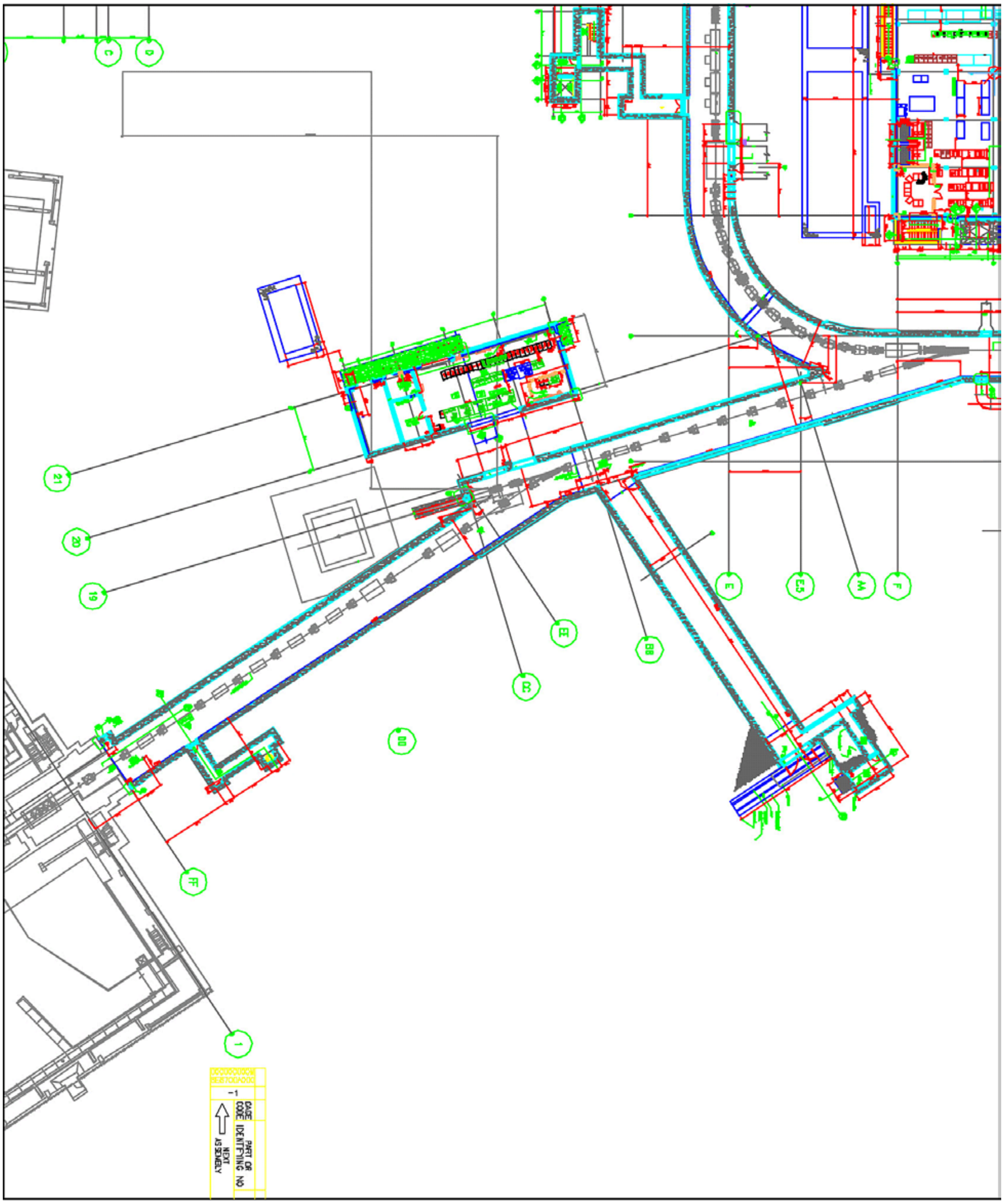


Fig. 29. RTBT general arrangement.

- Integrate with Global Controls System
- Conduct HEBT subsystem testing
- Install HEBT shield wall

The installation sequence for the ring subsections is covered in this section:

- WBS 1.05.02, Injection Systems
- WBS 1.05.03, D.C. Magnets
- WBS 1.05.04, Power Supply System
- WBS 1.05.05, Ring Vacuum System
- WBS 1.05.06, RF System
- WBS 1.05.07, Ring Systems Diagnostic Instrumentation
- WBS 1.05.08, Collimation and Shielding
- WBS 1.05.09, Extraction System

The component sequence of the ring installation assumes that the work starts at the "far point" from the ring access ramp and progresses back to the ramp. It is further assumed that there are two installation teams working in the ring at the same time. One crew will work in the north half of the tunnel, and the second will work the south half. This approach prevents components installed later from passing work in progress or finished, aligned components. It also provide unobstructed to the HEBT for cryogenic transfer line installation

The Ring installation sequence is as follows:

North Crew

- Verify integrity of global alignment network
- Survey and mark technical components locations
- Install cabling
- Install injection septum INJSEPM1
- Install corrector DCHVA 10
- Install quadrupole QHA10
- Install quadrupole QVA11
- Install magnets in sequence to DCHVA13
- Install injection dump subsystem
- Install four kicker magnets—INJKV3, INJH3, INJKV4 and INJKH4
- Install to arc half-cell position 9
- Install gate valve
- Verify vacuum leak check of north west quadrant
- Subsystem test of northwest arc half cells
- Install two collimators
- Install corrector DCHVB10, quadrupole QHB10, and quadrupole QVB11
- Install quadrupole QVB12, quadrupole QHB13, and CORRECTOR DCHVB13
- Install collimator
- Connect collimator cooling water system
- Test collimator cooling water system
- Verify vacuum leak check of collimator region
- Subsystem test of collimators
- Install eight arc half-cells and associated quadrupoles/correctors through DCVC9
- Install gate valve
- Verify vacuum leak check of northeast quadrant
- Subsystem test of northeast arc half-cells

- Install EK 1-7 fast extraction kicker
- Install two quadrupoles—QHC10, QVC11 and Corrector—DCHVC10
- Install EK 8-14 fast extraction kicker
- Verify leak check of fast kicker region
- Verify leak check of North arc
- Connect magnet cooling water system
- Test magnet cooling water system
- Verify alignment of North arc
- Certify MPS system
- Certify personnel protection system
- Perform subsystem test of North ring section

South Crew

- Verify integrity of global alignment network
- Survey and mark technical components locations
- Install cabling
- Install injection kickers INJKV2, INJKH3, INJKV1 AND INJKH1
- Verify leak check of injection kicker region
- Install eight southwest arc half-cells and associated quadrupoles/correctors beginning with DCVA9
- Install gate valve
- Verify leak check of southwest arc half-cells
- Subsystem test of southwest arc half-cells
- Install two quadrupoles—QHD13 and QVD12 and corrector—DCHVD13
- Install four RF cavities
- Connect RF cavities cooling water system
- Test RF cavities cooling water system
- Install two quadrupoles—QVD11 and QHD10 and corrector—DCHVD10
- Install eight southeast arc half-cells to corrector DCV01
- Install gate valve
- Verify vacuum leak check of southeast quadrant
- Connect magnet cooling water system
- Test magnet cooling water system
- Subsystem test of southeast arc
- Verify south arc alignment
- Certify MPS system
- Certify personnel protection system
- Subsystem test of south arc

The installation sequence for the Ring Service Building subsections is as follows:

- Install HEBT (north of break) power supplies and controls
- Install ring main dipole water-cooled bus
- Pull south duct work cable
- Install ring reference dipole
- Install ring dipole power supply
- Install quadruple power supplies
- Install corrector power supplies (mezzanine)
- Install remaining RSB technical components
- Integrate with Global Controls System
- Certify personnel protection system

- Perform Ring subsystem test
- Install RTBT (north of break) power supplies

The RTBT installation sequence is as follows:

- Verify integrity of global alignment network
- Survey and mark technical components locations
- Install cabling
- Install last rad hard quad at the Target Building wall at the east end of the RTBT tunnel
- Install beam line back toward the RTBT tunnel leaving out the 15° dipole for safety. (Trial fit dipole —Remove and store in tunnel)
- Stop technical components installation last magnet south of the RTBT access tunnel.
- Install last two rad hard quadrupoles adjacent to the Target last through Target Building
- Harp and proton drift tube are provided to Target Group
- Target Group mounts harp and proton drift tube on Target window
- Target Group mounts Target window assembly on Target vessel
- Install from quadrupole QV1 at start of RTBT back to RTBT ramp
- Re Install 15° Dipole
- Verify vacuum leak check of RTBT
- Connect magnet cooling water system
- Test magnet cooling water system
- Verify RTBT alignment
- Subsystem test RTBT

4. QUALITY ASSURANCE

4.1 QUALITY ASSURANCE REQUIREMENTS

This section implements QA requirements for the SNS, which are contained in the *SNS Quality Assurance Plan,* SNS-QA-P01.

4.2 QUALITY LEVELS

This plan also describes how these QA requirements will be met. The plan is comprehensive and covers a variety of systems installation activities. Central to the plan organization is a graded approach. Actions that ensure quality shall be applied commensurate with needs. Three grade levels (quality levels) are defined:

1. Serious potential impacts, requiring a disciplined set of actions.
2. Moderate potential impacts, justifying a balanced set of actions.
3. Routine potential impacts, justifying a flexible approach.

4.3 INSTALLATION QUALITY POLICY

Equipment/Systems/Components will be verified before installation as per the *SNS Quality Assurance Plan*, SNS-QA-P01, which describes quality assurance requirements and a graded approach to their application.

- Systems developed outside of the SNS QA program must undergo a qualification process (e.g., prototypes or R&D creations).
- Documented Verification Systems will be utilized. This affects assembly directions, startup procedures, etc. Test plans, formal inspections, and any other verifications should be traceable through Acceptance Criteria Listings (ACLs). Discrepancies and their resolution shall be documented through Inspection Discrepancy Reports (IDRs). A systematic set of verifications will give assurance in advance that the item to be installed is ready (pre-installation verification), that the installation is proceeding toward a successful conclusion once it begins (verifications during installation), and that successful completion of the installation has been achieved at the end (post-installation verifications.
- Deviations shall be recorded and notifications properly circulated.
- Quality assurance representatives (QARs) will participate in the verification process to ensure quality of the documents and turnover packages sent to SNS/ORNL. As part if the preparation for shipment, partner labs must provide a listing of applicable documents to SNS/ORNL.
- Turnover kits prepared by the partner labs should include applicable quality-related documentation (i.e., ACLs, IDRs, inspection reports, test results, certificates of conformance, material test certificates).

4.4 QUALITY ASSURANCE DOCUMENTATION

A critical component of the SNS QA Plan that impacts the ASD Installation team is the concept of ACLs. ACLs are made as part of the design process, updated during manufacturing and testing, and completed during installation and commissioning. ACLs are the primary tools used to organize the verification of completion of technical component installation. The successful completion of the subsystems testing without beam is recognized by the completion of the requirements identified on the ACLs. The completion of ACLs formalizes the preparation for turnover of technical components and subsystems from ASD Installation to ASD Operations.

The completion of the verifications for Installation/Operations turnover process is summarized using an additional set of forms, SNS Installation Verification (Attachment B). The installation verification process formalizes the accumulation of completed ACLs as well as the resolution of Inspection Discrepancy Reports (IDRs) and completion of installation document and records, including "as-builts." It proceeds in three stages: pre-installation, installation, and post-installation verifications.

4.5 ASSESSMENTS

Quality Assessments will be performed on the ASD Installation activities and procedures to verify their appropriateness and effectiveness.

5. ENVIRONMENT, SAFETY, AND HEALTH

5.1 ES&H REQUIREMENTS

The purpose of this section is to identify and summarize all the ES&H requirements that apply to ASD Installation activities. Appropriate references and contacts are provided to assist Installation personnel in the event of ES&H incidents that may occur during Installation activities. Although ES&H awareness and compliance are the responsibility of all Installation personnel, it is specifically a line management responsibility. ASD group leaders are responsible for ensuring that all group personnel are properly trained in the SNS ES&H policies and actions to be taken in response to those policies.

The ES&H requirements for ASD Installation personnel working on the accelerator site are contained in *Knight/Jacobs Joint Venture Environmental, Safety, and Health Plan*, SNS 108010300-PN00005-R02. A ten (10) hour training course on the K/J ES&H Plan is required for all ASD Group leaders ES&H requirements for activities in RATS or other ASD facilities are governed by the *SNS Environmental, Safety and Health Plan,* SNS-10203000000-ES0001-R00.

5.2 ES&H PLANNING

2.2.1 Work/Project Planning & Control System

SNS Installation activities will comply with the *ORNL Work/Project Planning & Control (WPPC) System*. The WPPC management system is the driver of all other management systems and establishes the process and requirements for executing the Laboratory's mission. The processes and requirements within the WPPC system apply to research and development activities, as well as to activities involving the design, operation, maintenance, modification, construction, demolition, or decommissioning of facilities or systems. Specifically, under WPPC Section 3.2.2 (Key Elements), ES&H planning and requirements are a central requirement of the ORNL planning process. Laboratory policy has established that all ASD Installation activities are defined as R & D.

Paragraph 1, "Proposal Development Phase," requires that "Risks and hazards for experimental design, systems operation, project design, and physical work are identified." Paragraph 2, "Project Authorization Phase," requires that "hazard controls are tailored to the work being performed and that consistent procedures for hazard control are in placed across the site." In addition to the identification and control of risks and hazards, the WPPC requires that detailed controls. SNS has a detailed "Job Hazard Analysis" process. The WPPC plan will provide the input to that detailed analysis.

The SNS ASD ES&H detailed planning process is defined in SNS Procedure SNS 104070400-PR-0003-R0, "Job Hazard Analysis".

Everyone at SNS is responsible for identifying and understanding hazards in the workplace. Understanding hazards and the risks they present is an essential foundation for achieving excellence in ES&H performance. Hazard analysis is a process by which personnel can plan work as well as identify and mitigate the ES&H hazards involved in any work activity. All activities in the work process are defined, understood, and anticipated by all those involved in the process.

All ASD Installation activities shall be reviewed in accordance with the "Job Hazard Analysis" procedure before work is initiated. While most work will require a Job Hazard Analysis, employees and supervisors are to use their professional judgment in determining the need for a written hazard analysis. The division safety officer (DSO) should be consulted for assistance with the Job Hazard Analysis process.

A special area of ES&H focus during the ASD Installation activities will be cryogenic hazard assessment. Because of the special ODH risks involved in an SC linac, special emphasis will be place on a job hazard analysis that cover this area and the training ASD Installation personnel must have to access that portion of the tunnel. DB craft personnel involved in installation of the linac must receive ODH training. Extensive engineering analysis has been done on the potential for an ODH hazard. Only in the most Extreme scenario would a worker be affected. To mitigate this risk, monitors and passive vents have incorporated into the accelerator facility design.

2.2.2 ES&H INCIDENT REPORTING

The discovery and acknowledgment of an event/incident—termed an occurrence—sets the event-reporting process in motion. If such an incident takes place, Knight/Jacobs and SNS management will investigate and analyze the mishap to discover the cause and prevent similar incidents from occurring. When an event is communicated to the SNS management, they will evaluate and categorize the event according to the guidance presented in Sect. 9 of DOE M 232.1–1A, *Occurrence Reporting and Processing of Operations Information*. The categorization level for an event drives a graded approach to the level of follow-up actions required for internal and external notifications, event evaluation, and analysis end event reporting. The main responsibility of ASD Installation personnel is to be aware of the reporting requirements and to respond to those requirements with a sense of urgency consistent to the specified reporting time limits. The primary action to be taken by ASD Installation personnel is to report an incident to the SNS facility manager. The facility manager will consolidate information and then, in consultation with the SNS ES&H manager, make the required notifications.

ASD Installation staff will complete the following tasks:

1. Initiate, as appropriate, immediate actions to mitigate or control the event.
2. Secure the scene of the event, as appropriate, to protect relevant evidence and information for any subsequent investigation.
3. Initiate appropriate response action to stabilize the event or to return activity to a safe condition.
4. Verbally notify the SNS ES&H manager as soon as possible no later than 2 hours after the incident.
5. Conduct an investigation to determine the causal factors.
6. Complete Form 102, "Incident Investigation Report," which contains corrective actions and an implementation schedule. In the event that corrective actions cannot be rapidly implemented, interim actions will be identified that will mitigate the hazard.
7. Provide to the SNS ES&H manager, within 48 hours of the event, a copy of the incident investigation report signed by Knight/Jacobs management.
8. Provide the SNS ES&H manager with a closeout report for each incident that summarizes the incident, causal factors, corrective actions, and completion dates. Knight/Jacobs management must sign this closeout report. The final report shall be submitted as soon as possible but no later than 40 calendar days after the initial categorization.

ASD Installation staff may be required to participate in oral or written notification of reportable incidents to appropriate personnel.

Complete requirements for occurrence reporting are contained in *SNS Occurrence Reporting Procedure,* dated September 24, 2001. Group leaders are responsible for ensuring that installation personnel assigned to their groups are properly trained in reporting requirements. Training will be performed by SNS ES&H.

6. INFRASTRUCTURE SUPPORT

The SNS is on a "green" site with installation activities that in most cases precede the completion of support facilities that are primarily focused on support operations after CD-4. Special emphasis must be placed on providing infrastructure to the ASD Installation team. Specific areas that require this attention are outlined in this section.

6.1 RECEIVING, ASSEMBLY, TESTING, AND STORAGE FACILITY (RATS)

The RATS facility is a 60,000 ft^2, air-conditioned building at 111 Union Valley Road, close to the main SNS office building at 701 Scarboro Road. The facility also includes 50 support offices, truck access/docks, and a 20-ton crane.

In principal, all shipments of ASD technical components will come to the RATS facility for inspection for shipping damage, collection of shipping documentation, and entry of appropriate information into the ORNL/SNS property management system. Many shipments will be immediately redispatched to SNS storage or be sent directly to the construction site for installation.

Activities in the RATS facility include assembly of cryogenic transfer lines, DTLs, CCLs, and HVCMs, as well as testing and/or measurement of magnets, ion sources, power supplies, vacuum components, and low-power RF activities.

Storage in the RATS facility will be limited to temporary requirements because the high-quality space within the building is too valuable to be used for storage. Additional storage requirements have been identified and are addressed subsequently.

A RATS "throughput" schedule is being developed that addresses the major activities in the facility. The schedule will address space requirements, personnel support resource loading, utilities/facilities support requirements, and the timing of these activities.

6.2 STORAGE SPACE

SNS has determined that the project requires 60,000 ft^2 of "conditioned" storage space in addition to the RATS facility. The first 30,000 ft^2 will be required in the second quarter of FY 2002. ORNL has allocated two buildings (7039 and 7605) that total ~30,000 ft^2 to meet this requirement. The second 30,000 ft^2 of storage will be required by the fourth quarter of FY 2002. The total of 60,000 ft^2 will be required for approximately 15 months after that date. The storage space requirement will then taper off as the movement of technical components into the tunnel/service building nears completion. A study is under way to determine the most cost-effective approach to providing the second 30,000 ft^2 on the site. The initial two buildings at ORNL will be returned to the Laboratory by the first quarter of FY 2004. See Fig. 30 for SNS storage requirements.

6.3 TRANSPORTATION

With the procurement of available storage space at ORNL, the ASD Installation team will need internally controlled transportation for moving technical components. This need will be met through the AE/CM Davis-Bacon subcontractor. Air ride trailer/cabs and handling equipment will be contracted for several months or for specific large moves/lifts. Davis-Bacon craft drivers and riggers under Knight/Jacobs supervision will operate this equipment.

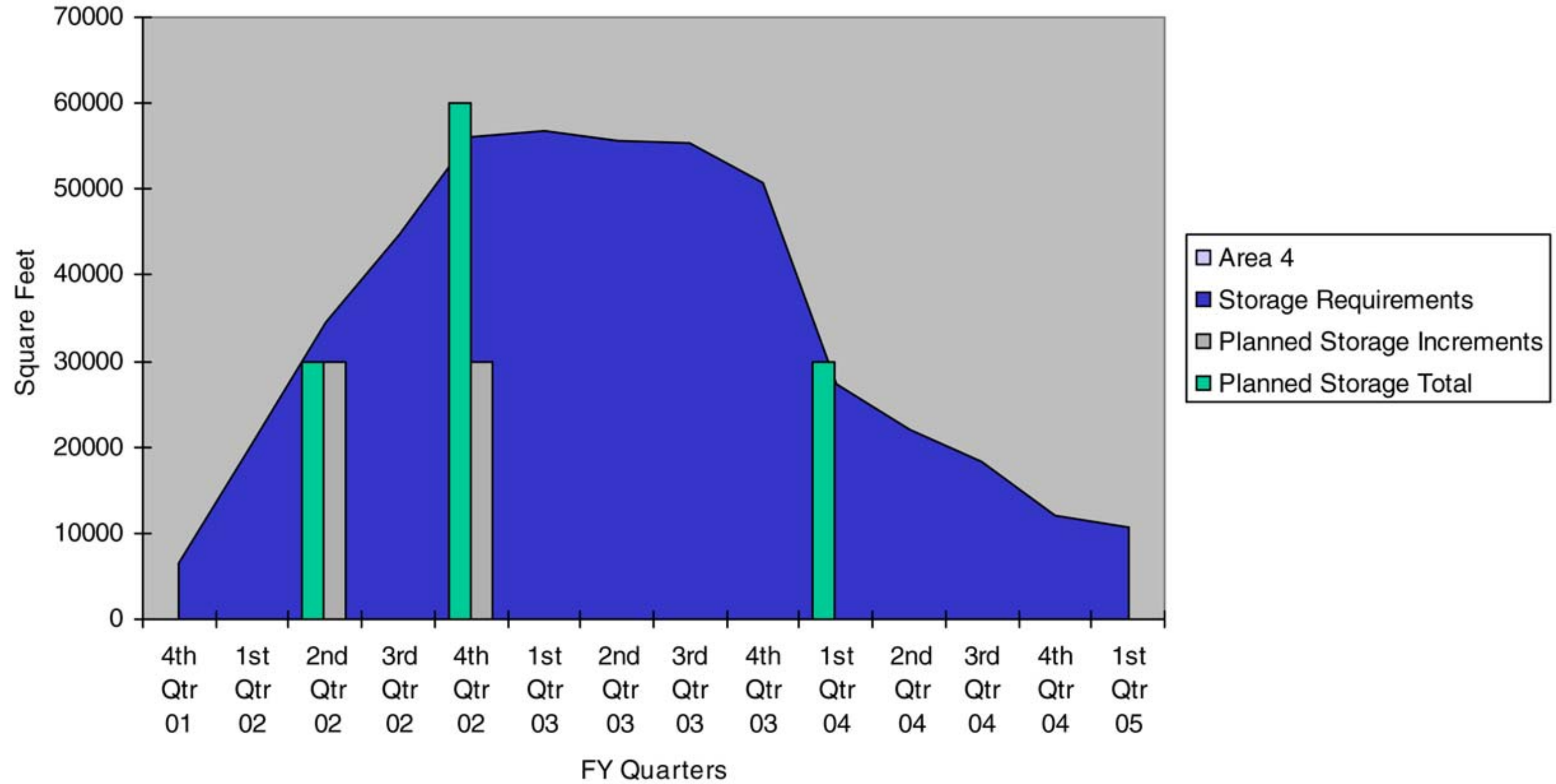


Fig. 30. SNS storage space summary

6.4 COMMUNICATIONS

The AE/CM site design includes the installation of hard-wired telephones on the site. The SNS Communications Coordination Committee has decided to provide Installation personnel with NEXTEL cell phones equipped with local conference call capability. Cell phone service in the accelerator tunnels will be supported with a "leakly" cable antenna system. Installation personnel will also be supplied with telephone headsets and belt-mounted units to be used in activities that require the use of both hands. Wireless LAN will be installed to support all buildings at the site and the accelerator tunnels. This will allow access to the project document databases, servers, and e-mail.

Standard alarms and speakers will be installed per ORNL requirements. These emergency notification systems will be coordinated with the ORNL Laboratory Shift Superintendents Office.

6.5 SUPPORT SHOPS

Plans are being developed to provide on-site light machine shop, stock room, and tool room support to the ASD Installation team by the RFE date of the FE Building in June 2002. If these support shops cannot be established on-site in the time required, they will initially be made operational in the RATS facility. As appropriate structures are completed on-site, the support shops will be moved.

7. SCHEDULE

7.1 PROJECT CONTROLS/ASD IPS INTERFACE

In general, ASD will ensure that all Project Execution Plan (PEP) milestones in the Integrated Project Schedule (IPS) are met in the ASD detailed schedule. Certain other IPS milestones, such as DOE-ORO milestones will be linked between the two schedules through agreement between the Project Controls Office and ASD Installation. All linked milestones are identified in Sect. 7.2.

7.2 ASD INSTALLATION MILESTONES

In general, the ASD Installation milestones are derived from the SNS project milestones. However, based on modified commissioning sequences, some modifications have been made while maintaining the early finish dates for major segments of the accelerator. The ASD Installation milestones are as follows:

Activity	Early Start	Early Finish	Note
RFE FE		03 June 02	
FE installation	07 June 02	01 Oct 02	
ASD pre-ops testing	02 Oct 02	01 Nov 02	
FE readiness assessment		30 Oct 02	
Start FE commissioning	01 Nov 02	26 Dec 02	DOE – ORO
FE–beam available to DTL		26 Dec 02	PET – 31 Mar 03
RFE 225-MeV linac tunnel	29 Mar 02		
RFE 225-MeV klystron hall	17 Jun 02		
Start 1st DTL tank (no. 3) installation	17 Jun 02		PEP - 30 Sep 02
6th DTL tank delivered to SNS	27 Mar 03		
Install DTL tanks	17 Jun 02	17 Jun 03	
1st & 2nd 4-MHz klystrons operational		15 Jul 02	
6th 402.5-MHz klystron operational		14 Mar 03	
DTL–system test–conditioning	24 Jul 02	05 Dec 03	
DTL–readiness assessment		17 Jan 03	
DTL 1st beam–commissioning	21 Jan 03	01 Apr 04	
DTL–beam available to CCL		01 Apr 04	
1st segment of CCL cavity available		01 Oct 01	
Last segment of CCL cavity available		14 Oct 02	
1st CCL klystron available	14 Jun 02		
Installation/conditioning (modules 2 to 4)	18 Jul 02	03 Jun 03	
CCL readiness assessment		08 Jun 04	
CCL 1st beam–commissioning	09 Jun 04	20 Aug 04	
CCL beam available to SC linac		20 Aug 04	
Start cryomodule installation	02 Sept 03		
Cryomodule installation	02 Sept 03	30 Sept 04	
SC installation complete		30 Sept 04	
CHL installation	19 Apr 02	22 Oct 03	
CHL/cryo system cool down	23 Oct 03	01 Mar 04	
SC system–conditioning	17 Jun 04	30 Sep 04	
SC readiness assessment		27 Sep 04	
SC operational		30 Sept 04	
BOD–linac dump	02 Jun 04		
SC commissioning	01 Oct 04	21 Dec 04	

Activity	Early Start	Early Finish	Note
SC beam available to HEBT		21 Dec 04	PEP - 31 May 05
RFE HEBT tunnel		01 Nov 02	
RFE ring tunnel	02 Dec 02		
Start ring installation	02 Dec 02		PEP – 28 Mar 03
Ring installation and testing	02 Dec 02	01 Dec 04	
BOD ring service building	09 May 03		
HEBT installation			
Start HEBT cavity installation	01 Jul 03		
Complete HEBT cavity installation			
BOD extraction dump	01 Dec 04		
BOD injection dump	02 Dec 04		
RFE RTBT tunnel		01 Nov 02	
BOD RTBT service building	30 Apr 03		
RTBT installation and testing	30 Apr 03	30 Jun 05	
RTBT 1st beam		22 Dec 04	
Target commissioning	01 Dec 05	30 Dec 05	PEP – 30 Jun 06
CD-4 project complete		30 Dec 05	PEP – 30 Jun 06
Finish project acceptance test		30 Dec 05	PEP – 30 Jun 06
Low-power testing	03 Jan 06	30 Mar 06	

7.3 ASD INSTALLATION SCHEDULE

The ASD installation schedule has been constructed using the Primavera Project Planner (P3). P3 is the professional project management software used by the SNS Project Controls group. ASD's selection of P3 will ensure compatibility of the installation schedule with the detailed project schedules and the integrated project schedule (IPS) thru PEP milestone links.

The installation scheduling process will begin with a detailed scope of work from the responsible lead engineers and/or physicists. This scope of work will be a step-by-step definition of all the activities required to install the technical components and subsystems that an individual is responsible for. These scope estimates will be made at the one-working-hour level. Many of these scopes will be repetitive because of the number of identical or similar systems in the accelerator. This scope-of-work input will be submitted to the ASD installation scheduler. The associate ASD director, section heads, installation manager, and the entire installation team will then subject it to review. Once the scope is accepted, the installation scheduler to develop durations that meet the IPS will use it, required resources, work distribution by skill and work-hour estimates and to propose installation budgets. After the installation baseline is established, it will be used to evaluate contingencies and work "arounds."

Once the ASD installation schedule is established at this very detailed level, tasks will be rolled up to higher levels where progress will be tracked and reported. This will provide the lead technical personnel with the appropriate authority to adjust day and weekly activities, yet still meet their significant milestones. It is anticipated that ASD Installation will have in operation approximately 20,000 to 25,000 activities.

7.4 COMPONENT DELIVERY SCHEDULE

Efficient installation of the SNS accelerator requires close coordination of the delivery of technical components from partner laboratories and vendors to the RATS facility. To achieve this coordination, a components delivery schedule has been initiated to track planned deliveries and purchase order commitments of technical components. This schedule will be used to ensure that deliveries adhere to the

ASD detailed schedule and to recommend to the ASD director instances where accelerated deliveries will result in more efficient and timely installation of the accelerator technical components. This schedule will be updated weekly until delivery dates are adjusted to support the ASD detailed installation schedule.

7.5 RATS FACILITY ASSEMBLY SCHEDULE

To coordinate the arrival of technical components with the requirements of the ASD detailed installation schedule, a RATS assembly schedule is required. This schedule will address all testing and assembly operations being conducted in the RATS facility, including those initially planned for completion at Oak Ridge and those transferred to Oak Ridge from partner laboratories. The major components and subsystems to be covered in this plan are as follows:

- Magnet measurement
- Power supply integration and testing
- Cryogenic transfer line fabrication
- DTL assembly
- CLL assembly
- Ion source hot test stand operations
- Vacuum system preparation and testing
- RF system low-power testing

7.6 INSTALLATION WORKING HOURS AND SHIFTS

This plan and the associated detailed schedule and installation cost estimate are based on two different working-hour assumptions. The transition point between the plans is at the interface between installation and commissioning. This working-hour change mainly impacts access to the various parts of the tunnel by installation personnel.

The plan is based on a regular five-day, eight-hour-per-day workweek until beam is initiated in sequential parts of the machine and commissioning begins. Once commissioning begins, installation personnel will work a four-day, ten-hour-per-day workweek. Commissioning personnel will work a three-day, ten-hour-per-day workweek.

For planning purposes: experience with accelerator installation/commissioning has shown that personnel work longer than any standard workweek. Expectations are that this also be the case for the SNS accelerator. This expectation is considered a contingency in the ASD installation schedule.

8. COST ESTIMATE

8.1 ACTIVITY PLANNING

A modification to the accelerator WBS has been adopted to identify new categories identified and organized during the third quarter of FY 2001. That new WBS will be used to define, cost, and track performance of ASD Installation activities (Fig. 31).

8.2 COMPOSITE CREW

The union trades council covered under the Knight/Jacobs Project Labor Agreement has agreed that union personnel provided to the Knight/Jacobs installation T&M subcontractor will work in composite crews. This means that installation efficiencies can be achieved by having an appropriate crew composition tailored to the requirements of the installation technical specialists. Crews may be made up of a mixture of millwrights and electricians as an example. Labor cost estimates will be developed based on this concept.

8.3 LABOR RATES

A composite labor rate has been developed to support the composite Davis-Bacon crew composition discussed in Section 11.1. That rate and the components in its structure are shown in Fig. 32.

An ORNL wage pool rate structure has been adopted for SNS. Those rates are shown in Fig.33. All rates are in FY01 dollars.

8.4 MATERIAL AND SUPPLIES COST ESTIMATES

M & S or expendables required to support the installation activities in the field have been estimated as 5% of the installation labor.

8.5 EQUIPMENT COST ESTIMATES

Equipment, hand tools, and small power equipment required to support the installation activities in the field have been estimated as 5% of the installation labor.

8.6 FACILITY COSTS

Facility costs such as storage, support shops, and other infrastructure required by a "green" site are funded by a project change request that reallocates other accelerator funds or contingency. These facility costs are not part of the ASD Installation cost estimate or budgets except for the RATS facility.

8.7 ASD INSTALLATION COST REPORTS

ASD group leaders are responsible for managing the cost performance of their personnel. Group leaders will prepare and submit all installation cost reporting required by the Project Controls Office. Beyond this requirement, the ASD detailed installation schedule will be used to establish a week-to-week cost tracking system that will provide more timely information with which to manage their activities.

Lead engineers will be required to plan weekly installation activities in hours. Lead Engineers will also be required to log daily progress against those plans and report that progress weekly at the weekly group leader installation meeting.

existing	ASD/ORNL Proposed Work Breakdown Structure 8/15/01	
yes	**WBS 1.3 Front End**	
yes	**WBS 1.3.5 FE Field Coordination**	Rename FE FC and Assembly
yes	1.3.5.1 FE Field Coordination	Rename FE FC and Assembly
yes	**WBS 1.4 Linac Systems**	
yes	**WBS 1.4.7 Linac Field Coordination**	
yes	1.4.7.1 Linac Field Coordination	
	1.4.7.1 History	
	1.4.7.1.4 RATS Building and Lease	
?	1.4.7.2 Design Confirmation Studies (Closed)	
?	1.4.7.3 Preliminary SC Activities (Closed)	
yes	1.4.7.4 RATS Building Techs	Rename Linac Installation Services
	1.4.7.5 Linac FC Power Supplies	
	1.4.7.6 Linac FC Diagnostics	
	1.4.7.7 Linac FC RF Power	
	1.4.7.8 Linac FC Cryomodules and Cyrogenics	
	1.4.7.9 Linac FC Mechanical	
yes	**WBS 1.4.16 ORNL Transfer Lines Fab Installation**	
yes	1.4.16.4 ORNL Ancillary Equipment	
yes	1.4.16.4.1 Y12 Purifier	
yes	1.4.16.5 ORNL Transfer Line/Piping	
yes	1.4.16.5.1 ORNL Transfer Line Facility Fabrication	
yes	1.4.16.5.2 ORNL Transfer Line/Warm Tunnel Piping	
yes	**WBS 1.4.17 ORNL Support to Cryomodule Fabrication**	
	WBS 1.4.18 ORNL Refrigeration System	
	WBS 1.4.19 ORNL Linac Assembly & Installation	
	1.4.19.1 ORNL RF Assembly and Installation	
	1.4.19.2 ORNL DTL and CCL Assembly & Installation	
	1.4.19.3 ORNL Diagnostics Assembly & Installation	
	1.4.19.4 ORNL SCL Assembly & Installation	
	1.4.19.5 AC Distribution, Trays and Cables	
	WBS 1.5 Ring Systems	
yes	**WBS 1.5.13 Ring Field Coordination**	
yes	1.5.13.1 Ring Field Coordination	
yes	Task funds by year	
yes	AS05130501 Foil Fabrication	
yes	1.5.13.2 Spares (To Be Closed After FY01)	
yes	1.5.13.3 Power Supplies Ring	Rename Ring FC Power Supplies
yes	1.5.13.4 Diagnostics Integration Ring	Rename Ring FC Diagnostics
	1.5.13.5 Ring FC Mechanical	
	1.5.13.6 Linac Installation Services	
	WBS 1.5.14 ORNL Ring Assembly & Installation	
	1.5.14.1 ORNL HEBT Assembly & Installation	
	1.5.14.2 ORNL Injection Assembly & Installation	
	1.5.14.3 ORNL Magnet Assembly & Installation	
	1.5.14.4 ORNL Power Supply Assembly & Installation	
	1.5.14.5 ORNL Vacuum Assembly & Installation	
	1.5.14.6 ORNL RF Assembly & Installation	
	1.5.14.7 ORNL Diagnostics Assembly & Installation	

Fig. 31. ASD Installation WBS.

	1.5.14.8 ORNL Collimation & Shielding Assembly & Installation
	1.5.14.9 ORNL Extraction Assembly & Installation
	1.5.14.10 ORNL RTBT Assembly & Installation
	1.5.14.11 AC Distribution, Trays and Cables
yes	**WBS 1.10 Pre-Operations**
	WBS 1.10.2 ASD Pre-Operations
yes	1.10.2.1 Management Group
yes	1.10.2.2 Operations Group
yes	1.10.2.3 Accelerator Physics Group
yes	1.10.2.4 Technology Groups
	1.10.2.4.1 RF Group
	1.10.2.4.2 Ion Source Group
	1.10.2.4.3 Cryomodule Group
	1.10.2.4.4 Cryogenics Group
	1.10.2.4.5 Power Supply Group
	1.10.2.4.6 Mechanical Group
	1.10.2.4.7 Vacuum Group
	1.10.2.4.8 Survey & Alignment Group
	1.10.2.4.9 Diagnostics Group
yes	1.10.2.5 Controls
	1.10.2.5.1 Controls Group
	1.10.2.5.2 Safety Systems Group
yes	1.10.2.6 Operational Support
yes	**WBS 1.1 R&D**
yes	WBS 1.1.12 ORNL Directed R&D
yes	1.1.12.1 PSR Instability

Fig. 31. ASD Installation WBS (continued).

Tentative 8/2001-5/2002 Craft Rates

Craft Journeyman	STR Billing Rate	Jacobs Fee	Subtotal	Craft Foreman	Subtotal	Lab Fee	Subtotal	Workman's Comp.	Total
		2.75%		**15%**		**1.98%**			
Electrician	38.34	1.05	39.39	5.91	45.30	0.90	46.20	2.81	49.01
Fitter	38.13	1.05	39.18	5.88	45.06	0.89	45.95	2.81	48.76
Millwright	35.16	0.97	36.13	5.42	41.55	0.82	42.37	2.81	45.18
Composite	**37.21**		**38.23**		**43.97**		**44.84**		**47.65**

STR Proj Mgr	51.16	1.41	52.57	0.00	52.57	1.04	53.61	2.81	56.42
STR ES&H Off	41.25	1.13	42.38	0.00	42.38	0.84	43.22	2.81	46.03
STR Proc Spec	17.66	0.49	18.15	0.00	18.15	0.36	18.50	2.81	21.31
Composite	**36.69**		**37.70**		**37.70**		**38.45**		**41.26**

	Max Workman's Comp.	
Dollars	984,500	= 2.81 per hour
Hrs	350,000	

As of 8/1/01

Fig. 32. Composite Davis-Bacon labor rate.

MPM Res Code	ORNL Wage Pool	FY 02 Base Planning Rates	FY02 * Org Burden	FY02 Subtotal with Org Burden	De-escalation Factor	FY01 Rate with Org Burden only	FY02 Ovhd Rate	Total Burd FY01 Rate
ORAdmin1	Admin 1	$ 30.68	$ 4.68	$ 35.36	1.025	$ 34.50	12.70%	$ 38.88
ORAdmin2	Admin 2	$ 41.18	$ 4.68	$ 45.86	1.025	$ 44.74	12.70%	$ 50.42
ORAdmin3	Admin 3	$ 52.19	$ 4.68	$ 56.87	1.025	$ 55.48	12.70%	$ 62.53
ORAdmin4	Admin 4	$ 65.21	$ 4.68	$ 69.89	1.025	$ 68.19	12.70%	$ 76.84
ORClerk1	Clerical / Secr 1	$ 24.08	$ 4.68	$ 28.76	1.025	$ 28.06	12.70%	$ 31.62
ORClerk2	Clerical / Secr 2	$ 32.44	$ 4.68	$ 37.12	1.025	$ 36.21	12.70%	$ 40.81
ORCraft1	Crafts 1	$ 26.30	$ 4.68	$ 30.98	1.025	$ 30.22	12.70%	$ 34.06
ORCraft2	Crafts 2	$ 31.29	$ 4.68	$ 35.97	1.025	$ 35.09	12.70%	$ 39.55
ORCraft3	Crafts 3	$ 37.77	$ 4.68	$ 42.45	1.025	$ 41.41	12.70%	$ 46.67
ORMgt1	Mgmt 1	$ 44.49	$ 4.68	$ 49.17	1.025	$ 47.97	12.70%	$ 54.06
ORMgt2	Mgmt 2	$ 62.10	$ 4.68	$ 66.78	1.025	$ 65.15	12.70%	$ 73.43
ORMgt3	Mgmt 3	$ 78.73	$ 4.68	$ 83.41	1.025	$ 81.38	12.70%	$ 91.71
ORMgt4	Mgmt 4	$ 95.80	$ 4.68	$ 100.48	1.025	$ 98.03	12.70%	$ 110.48
ORMgt5	Mgmt 5	$ 112.43	$ 4.68	$ 117.11	1.025	$ 114.25	12.70%	$ 128.76
ORMgt6	Mgmt 6	$ 130.25	$ 4.68	$ 134.93	1.025	$ 131.64	12.70%	$ 148.36
ORS&T1	S&T 1	$ 41.16	$ 4.68	$ 45.84	1.025	$ 44.72	12.70%	$ 50.40
ORS&T2	S&T 2	$ 52.87	$ 4.68	$ 57.55	1.025	$ 56.15	12.70%	$ 63.28
ORS&T3	S&T 3	$ 65.69	$ 4.68	$ 70.37	1.025	$ 68.65	12.70%	$ 77.37
ORS&T4	S&T 4	$ 77.58	$ 4.68	$ 82.26	1.025	$ 80.25	12.70%	$ 90.45
ORS&T5	S&T 5	$ 91.99	$ 4.68	$ 96.67	1.025	$ 94.31	12.70%	$ 106.29
ORS&T6	S&T 6	$ 113.74	$ 4.68	$ 118.42	1.025	$ 115.53	12.70%	$ 130.20
ORStudnt	Student	$ 14.90	$ 4.68	$ 19.58	1.025	$ 19.10	12.70%	$ 21.53
ORSupEng	Support Engr 1	$ 60.11	$ 4.68	$ 64.79	1.025	$ 63.21	12.70%	$ 71.24
ORTECH	Technician	$ 33.49	$ 4.68	$ 38.17	1.025	$ 37.24	12.70%	$ 41.97
		* Same as FY01 Org Burden rate (for planning purposes)						

Fig. 33. ASD Technical staff labor rates.

ACRONYMS AND ABBREVIATIONS

2-D	two-dimensional
3-D	three-dimensional
ACL	Acceptance Criteria Listing
A-E	architect-engineer
a/d	analog/digital
AASHTO	American Association of State Highway and Transportation Officials
ac	alternating current
ACWP	actual cost of work performed
ADC	analog-to-digital converter
AE/CM	architect-engineer/construction manager
AGS	Alternating Grading Synchrotron
ALARA	as low as reasonably achievable
ALD	associate laboratory director
AM/PM	amplitude modulation/phase modulation
ANL	Argonne National Laboratory
ANSI	American National Standards Institute, Inc.
AO	analog output
AP	accelerator physics
APPS	Accelerator Personnel Protection System
APS	Advanced Photon Source
APT	accelerator production of tritium
AR	accumulator ring
ARR	accelerator readiness review
ASAC	Accelerator Systems Advisory Committee
ASD	Accelerator Systems Division
ASE	accelerator safety envelope
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ATLAS	Argonne Tandem-Linear Accelerator System
BA	budget authority
BAC	budget at completion
BCM	beam current monitor
BCP	1. baseline change proposal 2. buffered chemical polishing
BCWP	budgeted cost of work performed
BCWS	budgeted cost of work scheduled
BES	Basic Energy Sciences
BESAC	Basic Energy Sciences Advisory Committee
BHWS	building heating water system
BIG	beam in gap monitor
BLM	beam loss monitor
BNL	Brookhaven National Laboratory
BO	budget outlay
BOA	basic ordering agreement
BOD	beneficial occupancy date
BPM	beam position monitor
BSS	beam shutdown station

BV	Bethel Valley Road
CAD	computer-aided design
CAE	computer-aided engineering
CAM	computer-aided manufacturing
CCB	Change Control Board
CCD	charge-coupled device
CCDTL	coupled-cavity drift-tube linac
CCL	coupled-cavity linac
CCR	central control room
CCTV	closed-circuit television
CD-4	critical decision-4
CDR	conceptual design report/review
CE	capital equipment
CEA	Centre d'Energie Atomique
CEBAF	Continuous Electron Beam Accelerator Facility
CEDB	Cost Estimate Database
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERN	European Organization for Nuclear Research
CERN SPS	CERN Super Proton Synchrotron
CESR	Cornell Electron Storage Ring
CF	Conventional Facilities
CFC	certified for construction
CFD	computational fluid dynamics
CFR	*Code of Federal Regulations*
CHL	central helium liquefier
CH-LLW	contact-handled low-level waste
CLO	Central Laboratory Office (Building)
CM	3. construction manager 4. cryomodule
CMP	Configuration Management Plan
COTS	commercial off-the-shelf
CPDS	construction project data sheet
CPI	cost performance index
CPR	Cost Performance Report
CPU	central processing unit
CUB	Central Utilities Building
CV	cost variance
CW	continuous wave
CWS	chilled water system
CY	calendar year
d/a	digital/analog
D&D	decontamination and decommissioning
DAC	digital-analog converter
DAS	data acquisition system
DB	database
DBA	design basis accident
DBE	design basis event
dc	direct current
DCC	Document Control Center

DCD	design criteria document
DCN	document change notice
DCWS	deionized cooling water system
DESY	Deutsches Elektronen Synchrotron
Dl	deionized
DIMP	design integration management plan
DIWS	deionized water system
DO	digital output
DOE	U.S. Department of Energy
DP	Defense Programs
DPA	displacements per atom
DTL	drift-tube linac
DVTS	design validation test stand
DWS	demineralized water system
e-p	electron-proton
EAC	estimate at completion
EDI	engineering, design, and inspection
EDIA	engineering, design, inspection, and administration
EDIS	Engineering Design and Information System
EFAC	Experimental Facilities Advisory Committee
EIS	environmental impact statement
EMI	electromagnetic interference
EMQ	electromagnetic quadrupole
EO	executive order
EPICS	Experimental Physics and Industrial Control System
EPS	Equipment Protection System
ER	Energy Research
ES&H	environment, safety, and health
ESS	European Spallation Source
ETC	5. estimate to complete 6. estimated total cost
EV	earned value
FBCM	fast beam control monitor
FBLM	fast beam loss monitor
FCO	field change order
FCR	field change request
FDDI	fiber-distributed data interface
FDR	final design review
FE	front end
FEB	Front-End Building
FEIS	final environmental impact statement
FEL	free electron laser
FELK	front end, linac, klystron
FES	front-end system
FFA	federal facility agreement
FFT	fast Fourier transform
FIFO	first in, first out
FMEA	failure mode effects analysis
FNAL	Fermi National Accelerator Laboratory
FODO	focus/defocus

FSAD	final safety assessment document
FSAR	final safety analysis report
FTE	full-time equivalent
FTP	file transfer protocol
FWHM	full width half maximum
FY	fiscal year
g/s	gallons per second
GeV	Gigaelectronvolt
GIS	Geographical Information System
gpm	gallons per minute
GSI	Gesellschaft fur Schwerionenforschung
GWTS	gaseous waste treatment system
H^-	hydrogen ion with a negative charge
H^+	hydrogen ion with a positive charge (aka proton)
H^0	neutral hydrogen
HB	high beta
HBLS	high-beta linac section
HEBT	high-energy beam transport
HEPA	high-efficiency particulate air (filter)
HEPL	High Energy Physics Laboratory
HERA	electron-proton accelerator at DESY
HETC	high-energy transport code
HFIR	High Flux Isotope Reactor
Hg	mercury
HMI	human-machine interface
HMIS	Hazardous Materials Inventory System
HOM	higher-order mode
HPRF	High-power radio frequency
HPTS	High-Power Target Station
HQ	headquarters
HV	high voltage
HVAC	heating, ventilating, and air conditioning
HVPS	high-voltage power supply
Hz	hertz
I/O	7. in/out 8. input/output
I&C	instrumentation and controls
IAT	instrument advisory team
ICD	interface control document
ICS	integrated control system
ICWG	integrated controls working group
ID	inner/inside diameter
IDD	interface design document
IDT	instrument development team
IGBT	integrated gated bipolar transistor
ILL	Institut Laue-Langevin
iMAN	Information Manager (software)
INEEL	Idaho National Engineering and Environmental Laboratory

INFN	Istituto Nazionale di Fisica Nucleare
IOC	instrument oversight committee
IPNS	Intense Pulsed Neutron Source
IPS	9. integrated project schedule 10. interruptible power supply
IS	Instrument System
ISA	Instrument Society of America
ISDD	Integrating System Design Description
ISN	integrated subproject network
ISO	International Organization for Standardization
ISMS	Integrated Safety Management System
IT	information technology
JAERI	Japan Atomic Energy Research Institute
JINS	Joint Institute for Neutron Sciences
JLAB	Thomas Jefferson National Accelerator Facility (preferred over TJNAF)
K	Kelvin
K/J	Knight/Jacobs
KCY	thousand cubic yards
KEK	High Energy Accelerator Research Organization (formed from Japanese abbreviation of Koh-Ene-Ken)
KeV	kiloelectronvolt
kPa	kilopascal
kV	kilovolt
kW	kilowatt
L/s	liters per second
LAMPF	Los Alamos Meson Production Facility
LAN	local-area network
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Science Center
LBNL	Lawrence Berkeley National Laboratory
LCC	life cycle cost
LDBT	linac dump beam transfer
LEBT	low-energy beam transport
LED	light-emitting diode
LEDA	Low Energy Demonstration Accelerator
LEP-200	Large Electron Positron Collider at CERN
LHC	large hadron collider
Lhe	liquid helium
LI	11. linac 12. line item
linac	linear accelerator
LLLW	liquid low-level waste
LLW	low-level waste
LLNL	Lawrence Livermore National Laboratory
LLRF	low-level radio frequency
LOE	level of effort
LOI	letter of intent
LOTO	lockout/tagout

LWC	lost workday cases
LWTS	Long-Wavelength Target Station
M&S	materials and services
M&TE	measuring and testing equipment
MA	milliampere
MBLS	medium-beta linac section
MCY	million cubic yards
MEBT	medium-energy beam transport
MeV	million electron volts
MHz	megahertz
MOA	memorandum of agreement
MOU	memorandum of understanding
MPM	microgram program manager
MPS	machine protection system
MS	millisecond
MSDS	material safety data sheet
MSSR	milestone schedule and status report
MTBF	mean time between failures
MTHL	mercury thermal hydraulic loop
MTTR	mean time to repair/mean time to restore
MV/m	megavolts per million
MVA	megavolt amps
MW	megawatt
N_2	nitrogen
nA/m	nano amps per meter
Nb	niobium
NC	normal conducting
NEC	National Electric Code
NEMA	National Electrical Manufacturer Association
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NIST	National Institute for Standards and Technology
NOI	notice of intent
NPDES	National Pollutant Discharge Elimination System
ns	nanosecond
NSF	National Science Foundation
NTRC	National Transportation Regulatory Commission
OD	outside/outer diameter
ODH	oxygen deficiency hazard
OFHC	oxygen-free high-conductivity
OPS	operations
OR	Oak Ridge
ORELA	Oak Ridge Electron Linear Accelerator
ORLAND	Oak Ridge Laboratory for Neutrino Detectors
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Operations
ORR	13. Oak Ridge Reservation
	14. operational readiness review
OSHA	Occupational Safety and Health Administration/Act

P&E	plant and equipment
PA	public address
PAC	15. Particle Accelerator Conference
	16. Program Advisory Committee
PC	personal computer
PCB	polychlorinated biphenyl
PCR	project change request
PDR	preliminary design review
PEP	project execution plan
PES	programmable electronic system
PFD	probability of failure on demand
PFN	pulse-forming network
PLC	programmable logic controller
PMB	performance measurement baseline
POP	proof of principle
ppp	particles per pulse
PPPL	Princeton Plasma Physics Laboratory
PPS	17. Personnel Protection System
	18. pulses per second
PS	19. power supply
	20. project support
PSAD	preliminary safety assessment document
PSAR	preliminary safety analysis report
PSI	Paul Scherrer Institute
PSR	proton storage ring
PVC	polyvinyl chloride
PWS	process water system
PWTS	process waste treatment system
QA	quality assurance
QAL	quality assessment letter
R&D	research and development
RAM	reliability, availability, and maintainability
RATS	receiving, acceptance, testing, and storage
RCRA	Resource Conservation and Recovery Act of 1976
rf/RF	radio frequency
RFE	ready for equipment
RFI	radio-frequency interference
RFP	request for proposal
rfq/RFQ	radio frequency quadrupole
RGA	residual gas analyzer
RHIC	Relativistic Heavy-Ion Collider
RH-LLW	remote-handled low-level waste
RI	21. recordable injury
	22. ring

rms	root mean square
ROD	record of decision
RRR	residual resistivity ratio
RTBT	ring-to-target beam transport
RWP	radiation work permit
SAC	Scientific Advisory Committee
SAD	safety assessment document
SANS	small-angle neutron scattering
SAR	safety analysis report
SC	23. safety class
	24. superconducting
SCD	single-crystal diffraction
SCL	superconducting linac
SHUG	Spallation Neutron Source/High Flux Isotope Reactor User Group
SIL	safety integrity level
SINQ	spallation neutron source at the Paul Scherrer Institute
SIS	safety-instrumented system
SLAC	Stanford Linear Accelerator Center
SNS	Spallation Neutron Source
SOD	Site Operations Division
SOW	statement of work
SPI	schedule performance index
SRD	systems requirement document
SRF	superconducting radio frequency
SS	stainless steel
SSC	Superconducting Super Collider
STL	senior team leader
SV	schedule variance
SWS	sanitary water system
T	ton
TBD	to be determined
TCP/IP	transfer control protocol/internet protocol
TCWS	tower cooling water system
TDEC	Tennessee Department of Environmental Conservation
TDOT	Tennessee Department of Transportation
TDR	time domain reflectometer
TEC	total estimated cost
TESLA	TeV Energy Superconducting Linear Accelerator
TFTR	Tokamak/Toroidal Fusion Test Reactor
TH	thermal hydraulic
TIAC	Target Instrument Advisory Committee
TiN	titanium nitride
TJNAF	Thomas Jefferson National Accelerator Facility (JLab is preferred)
TL	transfer line
TOF	time of flight
TPC	total project cost

TPS	target protection system
TS	Target System
TSCA	Toxic Substances Control Act
TSR	technical safety requirement
TTF	25. Target Test Facility 26. TESLA Test Facility
TVA	Tennessee Valley Authority
UHV	ultrahigh voltage
UL	Underwriter's Laboratories, Inc.
UPS	uninterruptible power supply
URL	uniform resource locator
VAR	variance analysis report
VME	Versa Module European (type of bus)
WBS	work breakdown structure
WCM	wall current monitor
WNR	weapons neutron research
WP	work package
WTHL	water thermal hydraulic loop
XFD	Experimental Facilities Division

ATTACHMENT A

SNS ACCELERATOR TURNOVER PLAN

SNS-100000000-PN0001-R00

SNS Accelerator Turnover Plan

10/02/2001

SNS Turnover Plan

Introduction

The Spallation Neutron Source (SNS) accelerator is being designed and procured by Lawrence Berkeley, Los Alamos, Jefferson, Brookhaven, and Oak Ridge National Laboratories, with ORNL responsible for overall integration and subsequent installation and operation. The complexity of SNS necessitates a clear understanding among all parties regarding the hand-off of components and systems from partner Laboratories to Oak Ridge. The purpose of this plan is to document the process for specific systems and sub-systems, including the delineation of items to be delivered, including documentation and databases, and the identification of responsibilities. The transfer must be congruent with available resources and budgets; define success for partner Laboratories; and phase in SNS personnel to assume responsibility for systems.

Process

Workshops were held with each partner Laboratory and SNS personnel to discuss the hand-off on a system-by-system basis. The workshops identified specific topics, such as activity sequence, documentation, procurements, warranties, latent defects, and staffing, which had to be addressed as part of the transfer.

Transfer points Generally agreed on top-level turnover. Designated lead persons for each subsystem to develop acceptance criteria. After agreement reached on criteria, incorporated into ETC. Partner labs estimated effort they will lead, ORNL estimated for when SNS will be leading.

Results

Initially, General L-M-C concept. General discussion of common results: procurement responsibility stays with partner Labs; SNS participates in factory/acceptance testing. SNS personnel learn systems at partner Labs. Partner Lab typically leads first article testing at varying degrees of integration/complexity. In several cases, also lead installation and checkout. Subsequent items physically transferred at RATS, with acceptance contingent upon passing specific tests.

Descriptions of the process for major systems follows. Detailed acceptance criteria forms in the appendix. These criteria use existing testing program rather than establishing independent ORNL process.

Control Systems

System Description

The Accelerator Control System is a highly distributed system which may be thought of in two, broad categories: “Global” Subsystems and Distributed I/O Subsystems.

Global Subsystems are those used throughout the facility, and include the Communication Network, the Timing and Synchronization System and the Machine Protection System. The network consists of fiber and commercial network “switches” linking all of the computing nodes of the control system. The timing and protection systems include common hardware that is dispersed among the distributed I/O subsystems, as well as the fiber connecting these components. Both systems include complex supervisory software.

The Distributed I/O Subsystems consist of Input-Output Controllers (IOCs) that include local processors and either I/O modules (e.g. digital-to-analog converters, motor controllers, etc.) or fieldbus controllers to communicate with the devices which make up the accelerator subsystems, such as the vacuum, power supply, cooling, radio frequency and beam instrumentation subsystems. These systems are designed at the partner laboratories by controls group teams working with the subsystem developers.

Turnover Process

Although components of the Global Subsystems are developed at the partner laboratories, overall responsibility resides at ORNL, so handover issues are minimal. The network is entirely the responsibility of ORNL, and there are no handover issues. Timing and protection system modules will be integrated into the IOCs where they are assembled (see below).

The Distributed I/O Subsystems (IOCs) are treated as a part of the subsystems they control, and are included, explicitly or implicitly, in the turnover process for those subsystems. Thus, wherever a subsystem is assembled, integrated and tested, there is the associated IOC assembled, integrated and tested. In the case of some highly repetitive subsystems such as the Linac RF, the early systems are assembled and tested by partner laboratory staff, while the later ones are assembled and tested at SNS/ORNL by ORNL staff. In these cases, the same protocol is followed for the IOCs.

Software developed at the partner laboratories in support of these subsystems – EPICS databases, applications and operator screens – are developed from the outset using an ORNL-based Application Development Environment (ADE), and drawing common code from that repository. Thus the code will already reside at SNS/ORNL, and no special turnover should be needed. At least that’s the theory.

Special Test/Installation/Support Equipment

In general, common laboratory equipment can be used for installation, testing and support of distributed control subsystems, and this equipment will be provided by SNS/ORNL.

However, any special equipment developed or purchased by the partner laboratories for these functions will be delivered to SNS/ORNL with those subsystems.

Software & Databases

Software drivers for modules of the global system are developed at the laboratories where the modules themselves are developed. These drivers are delivered with the modules. High-level applications for the timing and protection systems are developed at SNS/ORNL, and no turnover is required.

As noted above, all software developed in support of IOCs, wherever developed, is maintained on the ORNL ADE. This includes the EPICS portion of the SNS-wide Oracle technical database, and all application code.

Documentation

Documentation for the Global Subsystems is the responsibility of SNS/ORNL. Where specific modules in this subsystem have been developed at the partner laboratories, these laboratories will supply complete drawing sets – schematics, board lay-outs and silk screens.

Each IOC will be accompanied by the following documentation:

Requirements description
Functional description
Complete signal list, with signal properties and names
Assignment of signals to I/O modules or addresses
EPICS database documentation, including graphical representation where applicable.
SNL listings, where applicable
Installation drawings and procedures
Test procedures, and test results where applicable
Cable drawings, including internal rack cabling.
User documentation associated with screens
All manuals and vendor documentation for modules used in the IOC

Ion Source/LEBT

System Description

The ion source (3 units) and LEBT consist of the following components:

- Ion source and LEBT mechanical structures, vacuum systems, support structures, LEBT diagnostic plate, isolation gate valve, and high-voltage enclosure.
- Source/LEBT electronic systems, consisting of rf plasma drive systems, source and LEBT power supplies, chopping electronics, and safety system.

Turnover Process

The ion sources and LEBT will be fully commissioned with beam at LBNL as part of the overall Front End commissioning. Following demonstration of acceptance criteria, they will be dismantled, shipped directly to SNS, and re-installed in the front end building. ORNL personnel will be present during commissioning and disassembly at LBNL, and a limited number of LBNL personnel will assist with installation and re-commissioning at SNS.

Special Test/Installation/Support Equipment

The following items will be used to support testing/commissioning at LBNL and will not be shipped to SNS:

- Standard electronic test equipment such as oscilloscopes, multimeters, waveform analyzers, and so forth.
- External diagnostics chamber with emittance devices and Faraday cup.

ORNL will provide this equipment as needed.

LBNL will deliver the procured items for the Test and Maintenance Stand

Software & Databases

ORNL will provide commissioning applications programs.
LBNL will provide copies of the local software used during commissioning at LBNL.
LBNL will enter cable data into the SNS cabling database.

Documentation

LBNL will provide the following at the time of equipment delivery:

- As-Built Drawings
- Native CAD files
- Test Results/ QA records (Traveler)
- Installation sketches and procedures
- Cabling drawings
- Vendor-supplied documents (power supply operating manuals)

RFQ/MEBT

System Description

The RFQ consists of the accelerator structure, high-power and low-level rf systems, waveguide system and rf couplers, vacuum systems, the support structure, two temperature controlled closed loop water systems, diagnostics and safety systems.

The MEBT consists of 14 quadrupole electromagnets and their power supplies, diagnostics and instrumentation apparatus, vacuum equipment, the support structures, four rebuncher cavities and their rf supplies, 4 low-level rf systems, as well as the MEBT chopper and anti-chopper structures with their power supplies, and a chopper target.

Turnover Process

The RFQ and MEBT will be fully commissioned with beam at LBNL as part of the overall Front End commissioning. Following demonstration of acceptance criteria, they will be separated and partially dismantled, shipped directly to SNS, and re-installed in the front end building. ORNL personnel will be present during commissioning and disassembly at LBNL, and a limited number of LBNL personnel will assist with installation and re-commissioning at SNS.

Special Test/Installation/Support Equipment

The following items will be used to support testing/commissioning at LBNL and will not be shipped to SNS:

- Standard electronic test equipment such as oscilloscopes, multimeters, waveform analyzers, and so forth.

ORNL will provide this equipment.
LBNL will supply a full-power beam stop and a one-channel transverse emittance device.

Software & Databases

ORNL will provide commissioning applications programs.
LBNL will provide copies of the local software used during commissioning at LBNL.
LBNL will enter cable data into the SNS cabling database. LBNL will provide magnet measurement data, as available*, <note that the MEBT magnets have not been 'mapped' in the full meaning of this term>* in the "global database" format.

Documentation

LBNL will provide the following at the time of equipment delivery:

- As-Built Drawings
- Native CAD files
- Test Results/ QA records (Traveler)
- Installation sketches and procedures
- Cabling drawings
- Vendor-supplied documents (power supply operating manuals)
- Copy of the Commissioning Logbook

High Power RF

System Description

The high power RF system (HPRF) has the same basic physical configuration for all types of klystrons and frequencies: klystrons (with vac-ion pump, shielding, and solenoid); an oil-filled tank that houses the klystron(s); transmitter racks for klystron drive power, including magnet and ion pump power supplies, and associated interlocks; a cooling cart manifold to distribute and meter cooling water; and waveguide, including directional couplers and phase shifters, to transmit the RF power to the structures. The systems for the normal-conducting structures also include the cavity window. In addition to the above items, all cabling between technical components and water hoses will be supplied by LANL and installed by ORNL.

Turnover Process

The handoff of the HPRF systems will occur at both the component and system level. Components (klystrons, windows, loads, etc.) will be tested at vendors' facilities, and since vendors may lack full power test facilities, tests will be repeated at either LANL or ORNL. Components will be accepted at RATS based on successful factory acceptance testing or by successful high power testing at LANL or ORNL. Waveguide, circulators, and loads will be installed by ORNL personnel with appropriate LANL participation. Examples of appropriate participation include, but are not limited to, mutually agreed upon tasks such as phasing of the waveguide or calibration of the losses in the circulator or window. For the first 402.5 MHz, 5-MW 805 MHz and 550-kW 805 MHz systems, LANL will lead the installation and integration effort, culminating in high power conditioning/ non-beam commissioning. The first 402.5 MHz system is the RF station for the RFQ, DTL-1, and DTL-2. The first 5 MW, 805 MHz system is for the CCL-1. The first 550 kW system is for the first 12 SC cavities. Acceptance of these systems will occur after completing this final acceptance test. For subsequent systems, ORNL will lead the integration efforts, with LANL mentoring on later CCL and high-beta units. Acceptance of these subsequent systems will be at the component level at RATS.

Special Test/Installation/Support Equipment

For each type of transmitter, one air pad system for transporting the klystrons/oil tanks will be provided by LANL. For each type of klystron, certified lifting hooks, a lifting fixture, and instructions shall be provided by LANL in order to move the klystron with a crane. LANL will furnish all transmitter tank oil.

Software & Databases

Vendor supplied software and software documentation, updated/revised by LANL as needed during first article final acceptance. LANL will provide cable lists.

Documentation

LANL will provide the following at the time of equipment delivery:

- As-Built Drawings

- Test Reports/ QA records
- Installation procedures or installation drawings
- Vendor-supplied documents (handling instructions, installation procedures, operating procedures, shutdown/safety procedures, etc.).

High Voltage Power Conditioning

System Description

Two styles of high voltage power conditioning (HVPC) systems will be used at SNS, one that operates at 80 kV and one that operates at 140 kV. The HVPC systems have 6 different configurations, 1 for the RFQ and first 2 DTL's, one for the remaining DTL's, 1 for the CCL, 1 for the 12-klystron superconducting configurations, 1 for the 11-klystron superconducting configurations, and 1 for the HEBT cavities. The systems have the same basic physical configuration: an IGBT subassembly, a transformer assembly, a rectifier rack assembly, and an equipment control rack. Ground strips, and water hoses will be supplied by ORNL. All interface cabling between RF subsystems and facilities shall be provided under other work packages

Turnover Process

The handoff of the HVPC systems will occur at both the subsystem and system level. Subsystems (IGBT subassembly, transformer assembly, etc.) will be tested at vendors' facilities, with final assembly at ORNL. For the first 80 kV and 140 kV systems installed at ORNL, LANL will lead the installation, checkout and integration effort, including final acceptance testing to specification requirements. Acceptance of the first 80 kV and 140 kV systems will occur after completing this final acceptance test. LANL will also support non-beam commissioning in a "mentor" capacity. For subsequent systems, ORNL will lead the installation, integration, and high power conditioning (final acceptance test) efforts. These systems will be accepted at RATS based on successful subsystem factory acceptance testing.

Special Test/Installation/Support Equipment

For each type of HVPC, air pad systems for transporting the modulator tanks will be provided by the converter/modulator vendor. Standard test/measurement equipment will not be provided. All custom tooling and fixtures necessary to assemble, install, maintain, and ship HVCM subsystems and systems (if available from the converter/modulator vendor) shall be provided to ORNL at the time of first article delivery.

LANL will furnish sufficient Envirotemp FR3 dielectric fluid to fill all delivered HVCM units.

Software & Databases

Copies of software and documentation, updated/revised by LANL as needed during first article final acceptance. ORNL will enter cable data into the SNS cabling database.

Documentation

LANL will provide the following at the time of equipment delivery:

- As-Built Drawings
- Native CAD files
- Test Reports/ QA records

- Installation sketches and procedures
- Vendor-supplied documents (handling instructions, installation procedures, operating procedures, shutdown/safety procedures, etc.).
- Control Logix/RS Logix PLC software necessary to operate Allen Bradley PLC

Low Level RF System

System Description

The RF Control System consists of the high power RF protect module, the field/resonance control module, and a clock distribution module. It also consists of the temperature-stabilized reference coaxial line in the tunnel. The modules will be installed in VXIbus crates. LANL will supply the racks in the Klystron Gallery, and Controls, WBS 1.9, will supply the crates. In addition to the above items, all cabling between internal RF Control System technical components will be supplied by LANL and installed by ORNL.

Turnover Process

The handoff of the LLRF system will occur at the system level for the first two RF Controls Systems for each type of cavity: i.e., 402.5 MHz RFQ (1 system, obviously), 402.5 MHz DTL (2 systems), 805 MHz normal-conducting CCL (2 systems), 805 MHz superconducting medium β cavities(12 systems), and 805 MHz superconducting high β cavities (2 systems). For these initial systems, LANL will lead the equipment installation and integration effort through RF system integration and structure conditioning. To be clear, see the following table.

LANL lead	LANL Mentor	ORNL lead (LANL consult)
RFQ	-	-
1st 2 DTL	Next 2 DTL	Last 2 DTL
1st 2 CCL	Next 2 CCL	-
1st 12 medium beta	-	The rest of the medium beta systems
1st 2 high beta	Next 10 high beta	The rest of the high beta systems

ORNL will install, terminate, and test cables, and LANL will check these out as part of its integration effort. Acceptance of these systems will occur after integration. For the next two systems of each cavity type,, LANL will mentor ORNL in the installation and integration phase. For all subsequent systems, ORNL will lead the installation and integration efforts. Subsequent systems will be accepted after delivery to Oak Ridge based on successful module testing at the vendor.

The reference coax will be installed by ORNL crafts (supervised by ORNL technical staff), and tested by LANL and ORNL technical staff. It will be accepted as part of the first article, system tests.

Special Test/Installation/Support Equipment

Standard test/measurement equipment will not be provided by LANL; however, LANL will supply any special equipment required to simulate signals for the purposes of fully verifying operation and interlocks.

Software & Databases

Copies of software and associated documentation, updated/revised by LANL as needed during first article final acceptance, including:

1. Fully commented source code files, compiled files and all other related files for both FPGA and DSP chips.
2. Theory of operation technical note for all FPGA and DSP codes.
3. A step-by-step guide of how to edit/modify, compile, download, and run those codes.
4. Design simulation models/Matlab files

ORNL will enter cable data into the SNS cabling database.

Documentation

For each circuit module, LANL will provide a hardware description containing schematic/pcb/BOM (bill of materials) files, a users manual (operation manual), service manual (test procedure, trouble shooting), and a programming manual (apply to FRCM and HPM).

LANL also will provide:

- As-Built Drawings
- Test Reports/ QA records (Traveler)
- System connection diagrams for each kind (i.e. RFQ, DTL, CCL, and SRF), and turn-on /set-up procedures
- Cabling drawings
- Installation/test guide for the cabling, and frequency reference line

Drift Tube Linac

System Description

The Drift Tube Linac consists of six rf tanks with drift tubes, the vacuum system, support system, corrector magnets, beam boxes and associated racks with, controllers, ion gauges and power supplies. The DTL also consists of a resonance control cooling system. In addition to the above components, LANL will supply all cabling and piping between components. ORNL will provide manifolds and piping between the facility de-ionized water drops and magnet power supplies, and will furnish the waveguide support at the waveguide/tank interface.

Turnover Process

DTL tank assembly will be turned over to Oak Ridge after the assembly of the first two tanks (Tanks 3 and 1) at LANL. All drift tubes will be fiducialized at LANL. Rack assembly will be performed at RATS and the rack factory. LANL will lead the installation, assembly and RF conditioning of Tank 3. Acceptance of Tank 3 (and associated support systems such as water and vacuum systems) will occur after the completion of conditioning. Subsequent tanks will be installed by ORNL. Acceptance of these will occur with component delivery to RATS, based on satisfactory shipment and accomplishment of factory acceptance tests.

Special Test/Installation/Support Equipment

LANL will provide installation equipment and bead pull/tuning equipment.

Software & Databases

LANL will provide magnet mapping data in the “global database” format, and copies of software and software documentation for the water and vacuum systems. LANL will provide an Excel spreadsheet cable listing that ORNL will input into the SNS cabling database.

Documentation

LANL will provide the following at the time of equipment delivery:

- As-Built Drawings
- Native CAD files
- Test Results/ QA records (Traveler)
- Assembly and tuning procedures
- Installation sketches and procedures
- Cabling drawings
- Vendor-supplied documents (operating, repair manuals, etc).

Coupled Cavity Linac

System Description

The Coupled Cavity Linac consists of four rf modules, the vacuum system, support system, corrector magnets, electromagnetic quadrupoles, beam boxes and associated racks with, controllers, ion gauges and power supplies. The CCL also consists of a resonance control cooling system. In addition to the above components, LANL will supply all cabling and piping between components. ORNL will provide manifolds and piping between the facility de-ionized water drops and magnet power supplies.

Turnover Process

The CCL manufacturer will assemble the CCL modules and ship them to the RATS facility. Other items, such as magnet, vacuum, and water cart components will be shipped directly to RATS. LANL will lead the first module installation (module 2) and checkout at RATS, and ORNL will be responsible for subsequent modules. All magnets will be mapped and fiducialized at ORNL. Rack assembly will be performed at RATS and the rack factory. LANL will lead the installation and RF conditioning of CCL module 2. Acceptance of module 2 (and associated support systems such as water and vacuum systems) will occur after the completion of conditioning. Subsequent modules will be installed by ORNL. Acceptance of these will occur with component delivery to RATS, based satisfactory shipment and accomplishment of factory acceptance tests.

Special Test/Installation/Support Equipment

LANL will provide installation equipment.

Software & Databases

ORNL will provide magnet mapping data in the “global database” format. LANL will provide copies of software and software documentation for the water and vacuum systems. LANL will provide an Excel spreadsheet cable listing that ORNL will input into the SNS cabling database.

Documentation

LANL will provide the following at the time of equipment delivery:

- As-Built Drawings
- Native CAD files
- Test Results/ QA records (Traveler)
- Installation sketches and procedures
- Cabling drawings
- Vendor-supplied documents (operating, repair manuals, etc).

Superconducting Linac

System Description

The superconducting linac consists of medium and high beta cryomodules, warm sections containing diagnostics and focusing magnets, differential pumping stations, dummy beam pipe, and associated support systems (vacuum, power supplies). JLab is responsible for the design and assembly of the cryomodules, two differential pumping stations (design for the low energy station is shared jointly with LANL), the warm section beam pipe components, and vacuum control racks. LANL is responsible for the warm section magnets and power supplies, the magnet cooling cart and piping, and support stands. LANL also is responsible for diagnostics (see Diagnostics section). These diagnostics are shipped to JLab for incorporation into the warm beam pipe or the low energy differential pump and subsequent cleaning and bake-out.

Turnover Process

Cryomodule assembly and testing will be performed at JLab, with each cryomodule tested in the test cave. An extensive electronic traveler will be completed throughout the assembly and testing process. Cryomodules will be accepted at RATS based on achieving traveler criteria and demonstration of successful shipment. JLab will support cryomodule installation and checkout, with ORNL responsible for overall integration.

Magnets, power supplies, stands, and the cooling cart and piping/manifolds will be shipped from vendors directly to RATS upon confirmation of factory acceptance testing. Acceptance will occur after the completion of acceptance testing at RATS. Mapping and fiducialization will be performed by ORNL personnel.

Differential pumping stations and vacuum control racks will be assembled and tested at JLab and delivered to RATS. Turnover and acceptance will occur at RATS based on achieving traveler criteria and demonstration of successful shipment.

Special Test/Installation/Support Equipment

JLab will furnish tooling for cryomodule assembly, a roughing pump cart, and installation equipment and fixtures for the cryomodules and couplers. JLab also will provide test devices to verify connector/interlock operation.

Software & Databases

ORNL will provide magnet mapping data in the "global database" format. LANL will provide copies of software and software documentation for the water and vacuum systems. LANL will enter cable data for magnets and diagnostics into the SNS cabling database. JLab will enter cable data for vacuum systems into the SNS cabling database.

JLab will supply copies of all simulation/analysis models associated with the cavities and fundamental power couplers.

Documentation

JLab & LANL will provide the following at the time of equipment delivery:

- As-Built Drawings
- Native CAD files
- Test Results/ QA records (Traveler)
- Installation sketches and procedures
- Cabling drawings
- Vendor-supplied documents (operating, repair manuals, etc).

Cryogenics System

System Description

The cryogenic system for the linac consists of a 2.30 kW, 2.1K refrigerator using 4 stages of cold compressors, a 4.5 K subcooler, and a 2.1 K coldbox. The system also includes a dual tee shaped transfer line capable of connecting to 31 cryomodules, and a gas management system for distributing helium and nitrogen.

Turnover Process

Manufacturing and installation of the transfer lines has already been turned over to Oak Ridge. Components will be delivered either to the RATS facility for checkout/storage, or directly to the SNS site for installation (He tanks). The vendor will install the 4.5 K coldbox, and ORNL will install the remainder of the system with JLab consultation. JLab will lead the installation and testing effort for the 2.1 K coldbox, directing vendor and ORNL personnel during these phases. ORNL will install the gas management system. ORNL will issue fixed-price contracts for craft labor to support the 4.5 K and gas management installation activities.

Acceptance of these systems will be based on component operation tests (i.e. 100 hour warm compressor run) and overall system performance tests (i.e. 2 K operation for 4 hours).

Special Test/Installation/Support Equipment

TBD

Software & Databases

TBD

Documentation

JLab will provide the following at the time of equipment delivery:

- Test Results/ QA records (Traveler)
- Installation sketches and procedures
- Cabling drawings
- Vendor-supplied documents (operating, repair manuals, etc).
- Copy of the JLab CHL operating manual

ORNL will prepare as-built drawings at the end of installation.

HEBT/Ring/RTBT Magnets

System Description

The HEBT magnets include dipoles, quadrupoles, correctors, and associated bases and tunnel stands. The ring magnets consist of quadrupoles and ring half cells. In addition to a dipole, the half cell contains a strongback supporting a quadrupole, sextupole, corrector, beam position monitor, and a vacuum chamber. Acceptance criteria for diagnostics and vacuum components are identified elsewhere. For the RTBT, dipoles and quadrupoles, along with associated bases and stands, will be provided.

Turnover Process

All HEBT and RTBT magnets and stands will be shipped directly from vendors to the RATS building for subsequent testing and vacuum chamber/BPM installation. ORNL will measure and fiducialize these magnets. Stands will be accepted following inspection at RATS, and magnets will be accepted after completing an acceptance test.

Ring magnets will be assembled, mapped/fiducialized, and tested at BNL. Complete assemblies will be shipped to the RATS building. Following inspection and acceptance by SNS, they will be installed in the tunnel by SNS personnel.

Special Test/Installation/Support Equipment

BNL will supply a magnet transport trailer for magnet transport and installation.
ORNL will supply rigging and lifting equipment for installation.

Software & Databases

BNL will supply mapping data, in the global database format, for all ring magnets.

Documentation

BNL will provide the following at the time of equipment delivery:

- As-Built Drawings
- Native CAD files
- Test Results/ QA records (Traveler)
- Installation sketches and procedures
- Cabling drawings
- Vendor-supplied documents (operating, repair manuals, etc).

HEBT/Ring/RTBT Power Supplies

System Description

Power supplies include: (1) the main ring dipole power supply, main ring bus, and associated controls and protective circuitry, which will feed 33 dipole magnets, including a reference magnet; (2) the five main ring quadrupole power supplies and associated controls; (3) HEBT and RTBT quadrupole power supplies, SCR controlled continuous duty AC to DC converters; and (4) low power corrector power supplies.

Turnover Process

All of these power supplies will be procured from established vendors and shipped directly to the RATS building for checkout and installation (which will be performed by ORNL personnel). Power supplies will be accepted after completing acceptance testing at RATS based on specification requirements.

Special Test/Installation/Support Equipment

Instrumentation and field measurement for the reference magnet will be provided by BNL.

Software & Databases

TBD

Documentation

BNL will provide the following at the time of equipment delivery:

- As-Built Drawings
- Test Results/ QA records (Traveler)
- Installation sketches and procedures
- Cabling drawings
- Vendor-supplied documents (operating, repair manuals, etc).

Injection/Extraction Systems

System Description

The injection system includes the septum magnets, chicane magnets, horizontal and vertical pulsed dipoles, "bump" dipole magnets, injection foil mechanisms (ring and dump), and associated power supplies, bases and tunnel stands. Vacuum components and acceptance criteria are identified elsewhere.

The extraction system consists of vertical pulsed dipole magnets and associated stands, extraction kicker power supply system, lambertson septum magnet, and extraction lamberston power supply.

Turnover Process

The injection magnets and foil mechanisms will be assembled and tested at BNL, and then shipped to RATS for installation by ORNL personnel. BNL will measure and fiducialize these magnets and align other components. All stands and power supplies will be shipped directly from vendors to the RATS building for subsequent testing and installation. Power supplies will be accepted after completing acceptance testing at RATS based on specification requirements.

The extraction kicker power supply will be prototyped and tested at BNL, with additional modules fabricated by industry. The power supply will be shipped to Oak Ridge for final acceptance testing. The lambertson power supply will be shipped didrectly from the vendor to RATS. The extraction magnets will be assembled and tested at BNL. BNL will measure and fiducialize these magnets and align other components. The magnets will be accepted after completing acceptance testing at RATS based on specification requirements.

Special Test/Installation/Support Equipment

ORNL will supply rigging and lifting equipment for installation

Software & Databases

BNL will supply mapping data, in the global database format, for all injection/extraction magnets.

Documentation

BNL will provide the following at the time of equipment delivery:

- As-Built Drawings
- Native CAD files
- Test Results/ QA records (Traveler)
- Installation sketches and procedures
- Cabling drawings
- Vendor-supplied documents (operating, repair manuals, etc).

Ring/HEBT/RTBT Vacuum Systems

System Description

The ring vacuum system consists of arc half-cell chambers, straight section quadrupole chambers, adaptor bellows and pipes at straight sections, vacuum pumps, power supplies and controllers, sputter ion pumps and the associated power supplies, sector gate valves and valve controllers, turbopump/dry mechanical pump stations vacuum gauges, RGAs, PLC system and application codes. Hardware will be purchased based on SNS specification. Software will be developed by BNL personnel.

The HEBT vacuum systems, including Linac and HEBT dump regions, consists of dipole chambers, ion pumps, turbopump stations, gate valves, vacuum gauges and the associated power supplies and controllers.

The RTBT vacuum system consists of dipole chambers, ion pumps, turbopump stations, gate valves, vacuum gauges and the associated power supplies and controllers.

Turnover Process

Components will be fabricated by vendor or the BNL central shop per SNS drawings and specifications. The ring chambers will be welded together and assembled into magnets at BNL, tested then shipped to ORNL for installation and commissioning. For other components, the first article of each type will be tested at BNL, and subsequent items will be shipped directly from the vendors to RATS. Acceptance will occur after completion of acceptance tests at RATS.

Special Test/Installation/Support Equipment

Bakeout system for extraction kickers? TiN coating system? Will be delivered by BNL

Software & Databases

BNL will provide copies of application codes and documentation for the operation of valves, turbo-pumps, gauges, RGAs.

Documentation

BNL will provide the following at the time of equipment delivery:

- As-Built Drawings
- Native CAD files
- Test Results/ QA records (Traveler)
- Installation sketches and procedures
- Cabling drawings
- Vendor-supplied documents (operating, repair manuals, etc).

Ring RF System

The Ring RF system consists of the ferrite-loaded cavities, RF power amplifier, the power supplies needed to drive the power amplifier, the timing system, and the low level RF system. BNL will provide all cabling associated with technical components.

Turnover Process

RF system components will be assembled and tested at BNL and then shipped to ORNL. BNL personnel, i.e. a lead engineer, will work with SNS technical staff to install and integrate the system. Cable pulling and terminations, including RF and high voltage cables, will be done by ORNL personnel. The system will be accepted following the completion of an acceptance test based on SRD/DCD criteria.

Special Test/Installation/Support Equipment

ORNL will supply standard electronic equipment to support installatio/integration.

Software & Databases

Copies of software and associated documentation, updated/revised by BNL as needed during first article final acceptance. BNL will enter cable data into the SNS cabling database.

Documentation

BNL will provide the following at the time of equipment delivery:

- As-Built Drawings
- Test Reports/ QA records
- Installation sketches and procedures
- Cabling drawings

Collimators

System Description

The collimators consist of the collimator tubes, absorber, scraper assembly/exchange foil mechanism, and support stand. There are three collimators in the HEBT, three in the ring and two in the RTBT (a third RTBT collimator has been transferred to target systems).

Turnover Process

The collimators will be fabricated by vendors based on BNL specifications (BNL will coat the ring collimator tubes with TiN). The first item of each type of collimator will be tested at BNL and shipped to Oak Ridge.

Special Test/Installation/Support Equipment

TBD

Software & Databases

TBD

Documentation

BNL will provide the following at the time of equipment delivery:

- As-Built Drawings
- Test Reports/ QA records
- Installation sketches and procedures
- Cabling drawings

Diagnostics

System Description

Turnover Process

Special Test/Installation/Support Equipment

Software & Databases

Documentation

ATTACHMENT B

SNS INSTALLATION VERIFICATION

SNS Installation Verification

Draft

Installing Group: ____________________________ **Verifying Group** __________________________

Contact Name ____________________________ Contact Name ____________________________

Phone ___________ E-mail __________________ Phone ___________ E-mail __________________

Item Name ____

Item Number ____

Location(s) _________________________________ **Quantity** __________________________________

Additional Remarks ____

____

Purpose

This form is used to comply with requirements of the SNS Installation Plan and the SNS QA Plan and SNS QA Procedures.

Definition

Installation: Positioning an SNS system, component, or item of equipment or software (here called an item) in its permanent location in accordance with the current approved configuration and making all necessary attachments to allow normal use.

Stages of Installation Verification

A systematic set of verifications will give assurance in advance that the item to be installed is ready (pre-installation verification); that the installation is proceeding toward a successful conclusion once it begins (verifications during installation), and that successful completion of the installation has been achieved at the end (post-installation verifications).

The remainder of this multi-page form is the plan for, and record of, verification actions for the three stages of installation verifications. Final approvals are at the end of the last page.

Pre-Installation Verifications

Step	Description	Summary Record of Step Completion--action, attachment list, etc.	Verifier Name, Date & Signature
1.1	Confirmation that an approved set of design and procurement documents supports the item, and that those documents and records are compliant to requirements, such as accessibility through SNS Document Control and Records Management, (list documents).		
1.2	Review of any inspection and test reports from steps prior to and including receipt inspection and testing (list reports).		
1.3	Confirmation that Acceptance Criteria Listings (ACLs) have been completed through receipt inspection and testing steps (list ACLs).		
1.4	Resolution of any Inspection Discrepancy Reports (IDRs) (list IDRs).		

Pre-Installation Form Review

	Name	Signature	Date
Checked by Installing Group			
Quality Assurance Representative			

Verifications During Installation

Step	Description	Summary Record of Step Completion--action, attachment list, etc.	Verifier Name, Date & Signature
2.1	The records of inspections or tests that complete an installation task or a series of tasks will be retained as project records (list reports).		
2.2	A QA representative will monitor the documented inspection and test results, and may also witness the installation work and verifications as they are performed. Needed corrective actions will be tracked to closure (list monitoring activities and corrective actions).		
2.3	IDRs will be generated and used to explain further actions when inspections and tests show discrepancies (list IDRs).		

Post-Installation Verifications

Step	Description	Summary Record of Step Completion--action, attachment list, etc.	Verifier Name, Date & Signature
3.1	Results are as required by approved post-installation inspection and test plans (list plans).		
3.2	ACLs are completed through the installation verification step (list ACL numbers).		
3.3	Installation documents and records are compliant to requirements, such as accessibility through iMAN (list or describe documents and records).		
3.4	IDRs have been resolved suitably to support operation of the item (list IDRs).		

Completed Form Review

	Name	Signature	Date
Checked by Installing Group			
Quality Assurance Representative			
Acceptance by Operations			

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